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DR. MAX A. GOLDSTEIN
MEMORIAL ISSUE

Whereas: The American Speech Correction Association has lost by the death of Dr. Max A. Goldstein, not only one of its founders, but also a resourceful and productive scientist and a sympathetic friend, and

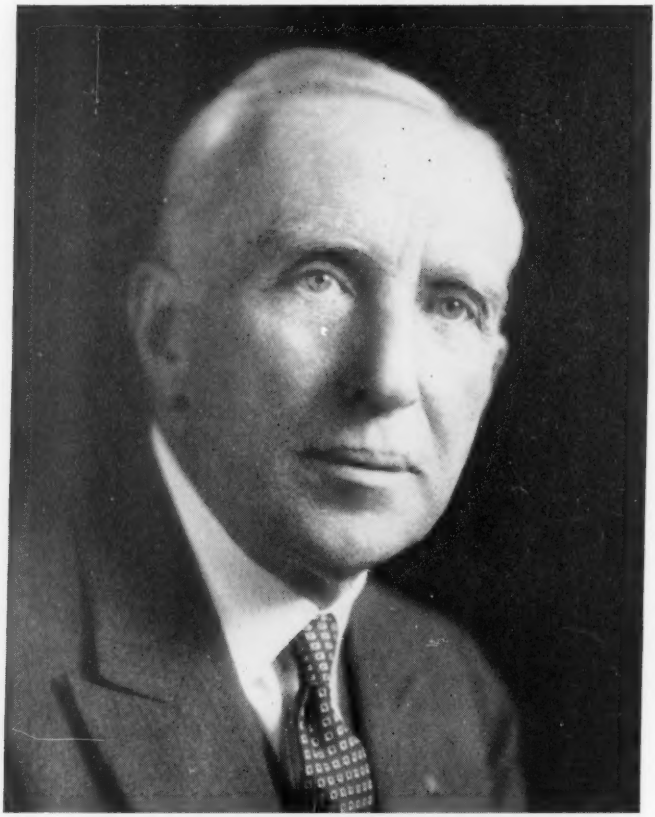
Whereas: The Association will continuously miss his courageous, devoted services and his wise counsel in its organization; his unswerving fidelity to high standards in methodology and his creative imagination in the research laboratory; and the fellowship of his rich, sympathetic personality, which so often gave direction and substantial aid to his associates toward the realization of their capabilities and ambitions:

Be it resolved that: The members of the American Speech Correction Association express here their great bereavement at his going and their grateful acknowledgment of the privilege of having lived so closely to one who so well demonstrated the fine art of living the good life.

—The American Speech Correction Association, in convention at Detroit, Michigan, December 29, 1941.

Resolution: An early issue of the Journal of Speech Disorders *shall be dedicated to the memory of the late Dr. Max A. Goldstein. This issue of the* Journal *shall be devoted to articles dealing with problems of the deaf and hard of hearing, particularly in their relation to speech correction; and it shall contain the memorial resolution adopted at the 1941 convention, a photograph of Dr. Goldstein, and a summary of his major contributions.*

—The American Speech Correction Association, in convention at Chicago, Illinois, December 29, 1942.



MAX A. GOLDSTEIN, M.D., LL.D.
1870—1941

Founder and Director, Central Institute for the Deaf; Professor of Otology, St. Louis University, 1900-1912; President, American Academy of Ophthalmology and Otolaryngology, 1902; President, American Otological Society, 1928; President, American Laryngological, Rhinological and Otological Society, 1931; President, Society of Progressive Oral Advocates, 1917-1938; President, American Speech Correction Association, 1936-1938; Editor, *The Laryngoscope,* 1896-1941.

MAX A. GOLDSTEIN, M.D., LL.D.
1870—1941

I. The Man and His Work

"Over the doorway leading to the tomb of Sir Christopher Wren at St. Paul's Cathedral there is a tablet which bears the following significant inscription: *Si monumentum requiris, circumspice.* (If it is a monument you want, look about you.) This expressive inscription could well summarize the life work of Max A. Goldstein. For he too built in his community a living and lasting monument—Central Institute for the Deaf."

Such was the eulogy delivered by Rabbi Julius Gordon at the last rites of a truly great man. These words referred in part to the Central Institute for the Deaf of which he was the founder and which, of all his achievements, was the closest to his heart. It was the fruition of a desire to help his fellow men, and the realization of a dream inspired during his student days in medicine in both the old world and the new.

Through his tireless energy and eager search for improved education of the deaf, this small institution became not only a laboratory for research aimed at more functional rehabilitation in communication and learning for these handicapped people, but also a center for neuro-anatomical study which Dr. Goldstein hoped would lead to a way to bring back a function that would take the deaf child out of his world of silence.

He was well aware that there were hidden mysteries that he could not unfold in his lifetime and he often repeated a prophecy that there would be better ways to educate the deaf after he was gone. It is sad to contemplate that life's span must be so short when there is such insistence of purpose and preparation for a mission—and it is the hope of those of us who have worked within the sphere of his inspiration and influence that we may carry this purpose a step further toward its fulfillment.

In 1894 Dr. Goldstein, then a young otologist, returned from postgraduate study abroad to engage in practice. Stimulated by contacts with teaching methods which he observed there, he brought back ideas in teaching speech to the deaf and in training to usefulness the residual hearing that so often lies dormant in the acoustically handicapped. This was his avocation in which he found opportunity to indulge his youthful fervor at the St. Joseph School for the Deaf in St. Louis. Since this work was related to his medical activities, his enthusiasm was not a passing fancy, but grew to be so challenging that he started a small school of his own in 1914 in a flat above his office at Vandeventer Avenue and Westminster Place, St. Louis, where he could devote spare moments to supervision, study and teaching. He secured the services of two teachers of the deaf

in 1914 and these two women and several children constituted the nucleus of Central Institute for the Deaf. Friends and patients of Dr. Goldstein watched the work with interest, and as the school outgrew its small quarters these friends contributed to a new building more commensurate in size with the increasing need for housing facilities for residential pupils. The new building was built farther west in the city on Kingshighway, where it stands today.

Teachers too were needed and young women were instructed by the classroom teachers in pedagogy for the deaf, while Dr. Goldstein imparted a background in the physiology, anatomy and pathology of the speech and hearing mechanism. Some of these early student teachers are still with Central Institute and more than 700 others have been trained since then.

While there had been provisions made for the teaching of hearing children with speech defects in the second year of the school, the free clinic for the correction of speech defects was not begun until 1926. It was held in the Washington University Medical School Clinic until Central Institute again outgrew its quarters and the present building was completed in 1929 to keep pace with growth in pupil enrollment and in research. Some of the earliest rehabilitation work in traumatic aphasia was done in this department and extensive work in congenital aphasia is still being carried on.

The Teachers' Training Course was expanded in 1929 to include a two-year professional curriculum and only students with two years of designated pre-professional college requirements were admitted to the Training Class. The Rockefeller Foundation contributed $125,000 to be used over a period of five years to establish research and courses that would insure the development of a curriculum which resulted in affiliation with Washington University. Dr. Goldstein was the first to see the necessity of a two-year professional curriculum for adequate preparation of teachers and Central Institute was the first Teachers' Training College offering a college degree for this training. In 1936, an affiliation with the School of Graduate Studies of Washington University made it possible for graduate students to receive a Master's Degree for professional training at Central Institute.

From the date of the founding of Central Institute the school has been recognized as a research center. This reputation was established and maintained by Dr. Goldstein, the scientist, whose interests were not limited to sciences related to medicine, such as physiology, neurology and anatomy, but also included physics, acoustics, psychology and genetics. Any scientific research touching the field of the deaf or speech defective child was welcomed; any new instruments became a part of the equipment of Central Institute for experimental

teaching; and any books or periodicals, new or old, that contributed to scientific and educational research with the deaf and speech defective were added to the research library, making it perhaps the outstanding of its kind.

Graduate students and scientists found in Dr. Goldstein a severe and sympathetic critic when research projects were presented and an enthusiastic co-worker when he was convinced of the value of the project.

Experiments transforming light into sound for the education of the blind led Dr. Goldstein to the belief that sound could be transferred into light for the instruction of the deaf. An engineer of the Westinghouse Company constructed an instrument for Dr. Goldstein which made sound visible and the name osiso was coined for it. Sound graphs could be photographed and studied, deaf children could attempt to imitate the sound graph of the pattern given by the teacher and several learned to interpret complex sound patterns.

In 1929, in the Psychology Laboratory of Central Institute Scripture's strobilion was remodeled to present pitch changes visually and to aid in teaching inflection.

About the same time the phonelescope, invented by a naval engineer, was put into use by Dr. Goldstein to make voice intensity visual by the variation in the height of a ribbon of light according to the volume of voice.

As both the strobilion and the phonelescope had to be used in a dark room and the lip reading of instructions was impossible, Dr. Goldstein turned his attention to the cathode-ray oscillograph. This indicated speech patterns similar to those of the osiso, but as the instrument was very sensitive to overtones, the patterns were too complex for the young deaf child.

A recent device to make pitch visible is called the thyratron inflector, and represented the research of a graduate student under the guidance of Dr. Goldstein.

As an important phase of the acoustic method, defined by Dr. Goldstein as "stimulation or education of the hearing mechanism and its associated sense organs by sound vibration," all forms of auditory amplification were used experimentally. Dr. Goldstein invented the Simplex tubes used to direct sounds to the deaf child's ears. He preferred the use of these tubes for the education of the young deaf child as they eliminated the danger of over-stimulation and did not introduce inaccuracies of electrical amplification.

In 1921, the Electrophone, one of the first electrical group hearing aids, was installed at Central Institute. Since that date many kinds of group aids have been used experimentally at the school.

For additional acoustic stimulation, Dr. Goldstein used a specially constructed organ to produce sustained tones for

sound stimulation for group or class work. A central resonating chamber is provided with outlets to accommodate several pupils simultaneously.

On one of his many trips to Europe he purchased specially built harmoniums to be used for musical stimulation in acoustic training.

In 1930, Dr. Lorente de No was invited to the laboratories of Central Institute by Dr. Goldstein. His extensive neurological research turned the attention of many scientists to the school. His work showed that action currents of the tensor tympani and stapedius muscles could be recorded as the evidence of hearing in experimental animals, and that the auditory nerve in appearance and function was like other sensory nerves. Dr. Lorente also distinguished three types of sensory endings in the Organ of Corti, making it possible to add new evidence relevant to auditory theory.

Because of Dr. Goldstein's interest in the diagnosis of deafness in infants, Dr. Helen Schick Lane was invited to the faculty of Central Institute and given the opportunity to do research on infants in order to develop a diagnostic test of hearing before the acquisition of speech. Experimentation at the Salvation Army Hospital yielded techniques using the conditioned reflex and galvanometric registration of the sudorific reflexes to indicate response to sound.

Further psychological research led to the adaptation and development of mental tests for the deaf and speech defective child, making it possible to obtain a fair measure of mental ability and demonstrating conclusively that the intelligence of these children follows a normal distribution curve.

Experimentation leading to improvement of the artificial larynx and educational research to provide better teaching methods in the use of this device were also projects of great interest to Dr. Goldstein.

In the field of genetics, he was interested in the hereditary transmission of deafness and under his direction Dr. Helen Lane was able to trace four generations of otosclerosis in the case of one pupil enrolled at Central Institute. This was the first study to show hearing impairment of such a type in every generation for four generations.

Eighteen years before the founding of Central Institute, in 1896, Dr. Goldstein founded *The Laryngoscope*, a monthly magazine devoted to the newest thought in otolaryngology. Among congratulatory letters received from the editorial staff on the Fiftieth Anniversary of this journal, Dr. Chevalier Jackson wrote, "You are to be congratulated for having founded one of the great otolaryngologic magazines in the world's literature." Despite the weighty burden of clinical and laboratory work, his medical practice and his beloved school, Dr. Goldstein

continued to edit and manage this journal until his death. It, as well as Central Institute, is being carried on. It is now edited by Dr. Walsh of Washington University Medical School and stands as a monument to Dr. Goldstein's memory.

Dr. Goldstein was not a man of single interest. He was tractable and open to all ideas, and none were too insignificant to escape his notice. His contagious friendliness encouraged the confidence of all those with whom he came in contact. Because his humanitarianism was of such a cosmopolitan nature, the fund of information gained from his contacts and constant study became increasingly abundant. Through his artistic gift of eloquent and precise expression, he had subjects at his command that could find an interested ear in any group.

Only those possessed of great vigor can crowd so much into one lifetime, and Dr. Goldstein was such a man. His leisure time was spent in productive activities. He traveled widely and brought back from Spain, France and other countries paintings and etchings to add to his valuable art collection. His collection of hearing aids is pictured in the *Problems of the Deaf*. Two of his outstanding collections were a series of ear bones of animals and fish, and Indian jewelry showing the historical sequence of its development.

The Elma Linz Levy Museum of Central Institute was dedicated in 1937. This gave Dr. Goldstein an opportunity to share a few of his many hobbies with the children of his school. It houses many of his collections such as those of Indian relics, mounted birds, animals and fish, butterflies, shells and bird eggs. In addition there are industrial exhibits given Dr. Goldstein to use in visual education of the deaf. The museum also provided an opportunity for the children to develop, under Dr. Goldstein's guidance, such hobbies as photography, bee culture, ceramics, stamp collecting and weaving.

He found time to build a completely equipped five-room doll house, constructed according to scale, which he presented to Central Institute for teaching purposes. He spent one summer in learning the art of cabinet making and the veneering of furniture. One year he built a trailer in which he and some of his friends enjoyed a summer in Minnesota and Michigan seeking out the best fishing grounds. He was interested in music and all sports, and his greatest thrill was to see any job well done, or any art or sport executed with the finest technique. He was a man of many interests, but only one mood which was dominated by friendliness, good humor, and consideration of others.

—*Mildred A. McGinnis, Chairman of the Department of Speech Correction, and Helen Schick Lane, Principal, Central Institute for the Deaf.*

MAX A. GOLDSTEIN, M.D., LL.D.

II. Biographical Summary

Goldstein, Max A., M.D., LL.D., Dir. of Central Institute for the Deaf, 818 South Kingshighway, St. Louis, Mo.; b. St. Louis, Mo., April 19, 1870, s. William Goldstein and Hulda (Loewenthal) G.; m. Leonore Weiner of St. Louis, June 4, 1895; c: Helen G. Wolff. Edn. Mo. Med. Coll. Med. Dept., Washington Univ., 1892; Post Grad., Otolaryngology, Berlin, Strassburg, Vienna and London, 1893-94. Exp.; Prof. of Otology, Beaumont Hosp. Med. Coll., 1895-1900; Prof. Otolaryn., St. Louis Univ., 1900-1912; Cons. Otolaryn., 1900-1912, City Hospital of St. Louis, Alexian Bros. Hosp., St. Mary's Hosp., Rebeccah Hosp., Mt. St. Rose Hosp. for Tuberculosis; Prof. Research Otology and Speech Pathology, Washington Univ., 1931-1941. Editor, The Laryngoscope, 1896-1941; Oralism and Auralism, 1922-1933; Dir. Central Inst., for the Deaf, 1914-1941, Dir. Dept. of Otolaryn., Jewish Hosp., St. Louis, 1927-1935; Dir. Amer. Fed. of Leagues for the Hard of Hearing; Dir. Amer. Soc. to Promote Teaching of Speech to the Deaf; Pres. Amer. Acad. of Ophth. and Otolaryn., 1902; Pres. Amer. Otol. Soc., 1927; Pres. Amer. L., R. and O. Soc., 1931; Pres. St. Louis Art League, 1917-1919; Pres. Society of Progressive Oral Advocates (now The National Forum on Deafness and Speech Pathology), 1917-1941; Pres. Amer. Speech Correction Association, 1937-39. Recipient of St. Louis Award, November, 1933, for outstanding civic service; Tendered a special Testimonial by the International Congress on the Deaf, June, 1933. Fellow Amer. Coll. of Surg., 1913-1941, and Amer. Med. Assn. Member St. Louis Med. Soc., Mo. State Med. Assn., Amer. Conf. of Supts. and Prin. of Schls. for Deaf, Acoustical Soc. of Amer., St. L. Chapter Archeological Inst. of Amer., Phi Beta Pi, Mu Iota Sigma. Major, Med. Corps, U.S.A., Chief Hd. Surg., Camp Dodge Cantonment Hosp., Des Moines, Iowa; Dept. of Rehabilitation Deaf and Defective Speech Soldiers, World War I. Honorary LL.D. Degree from Washington University, St. Louis, June, 1937. Spec. Interest: Art, Collector of books on early medicine in otology, deafness, speech, craniology, etc., Stamps, Fishing. Travel: Frequent trips to Europe, Mexico and throughout U.S.A.

III. Publications

Exfoliation of the cochlea, vestibule and semicircular canals. *Annals of Ophthalmology and Otology*, April, 1895.

The possibility of obtaining marked improvement in the treatment of deafness and supposed deaf-mutism by acoustic gymnastics; a system of vocal training of the auditory nerve as advocated by Urbantschitsch, of Vienna. *Archives of Otology*, 1895, XXIV.

Comparative value of the sense of hearing to the sense of sight. *The Laryngoscope*, Jan., 1896.

Advanced method in teaching the deaf. *The Laryngoscope*, Feb., 1897.

Fallacies in the physiology and functions of the labyrinth. *The Laryngoscope*, Sept., 1898.

The modern therapy of suppurative otitis media. *The Laryngoscope*, Dec., 1898.

Modern therapy of the tympanic cavity. *New York Medical Journal*, 1899, LXX.

Therapy of the tympanic mucous membrane. *The Journal of Laryngology*, Dec., 1899.

The physiology of voice production. *The Medical Fortnightly*, Sept. 10, 1900.

Report on the progress of laryngology and rhinology. *St. Louis Medical Review*, Aug. 16, 1902.

Primary tuberculosis of the ear followed by mastoiditis: report of four cases. *Journal of Laryngology, Rhinology and Otology*. March, 1903.

The use and abuse of the eustachian bougie. *The Laryngoscope*, July, 1903.

An unusual case of spontaneous, bilateral hemorrhage from the ear. *The Laryngoscope*, Aug., 1903.

The Oto-Projectoscope. *The Laryngoscope*, Feb., 1906.

Cosmetic and plastic surgery of the ear. *The Laryngoscope*, Oct., 1908.

Lipoma of larynx. *The Laryngoscope*, Sept., 1909.

The physician and the deaf child. *The Laryngoscope*, June, 1910.

The practical value of lip-reading. *The Laryngoscope*, May, 1911.

The Monochord. *The Laryngoscope*, March, 1913.

The deaf child; a plea for cooperation. *The Laryngoscope*, Oct., 1914.

The education of the deaf. *The Laryngoscope*, April, 1915.

Psychological study of the deaf child. *The Laryngoscope*, Sept., 1916.

The Society of Progressive Oral Advocates; its origin and purpose. *The Laryngoscope*, Sept., 1917.

Present status of the teaching of the deaf. *The Laryngoscope*, Sept., 1919.

An acoustic method for training the deaf. *The Laryngoscope*, July, 1921.

Classification of deafness from the standpoint of its pathology. Functional tests and pedagogy. *The Laryngoscope*, Sept., 1923.

Functional tests of hearing. *Oralism and Auralism*, April, 1924.

Potentialities of the audiometer. *The Laryngoscope*, July, 1925.

Practical demonstration of modern pedagogic methods in the training of the deaf child. *The Laryngoscope*, Jan., 1926.

The significance of the science of speech correction. *Annals of Otology, Rhinology and Laryngology*, March, 1926.

The acoustic method and its evolution. *Oralism and Auralism*, April, 1926.

The relation of tactile impression and hearing perception. *The Laryngoscope*, Oct., 1926.

Seeing sound. *The Laryngoscope*, Aug., 1927.

Further investigations of the special sense organs. *The Laryngoscope*, Oct., 1928.

Das Schwerhorige Kind. *Monatsschrift fur Ohrenheilkunde und Laryngo-Rhinologie*, (Vienna), 1931, Vol. 65, Heft. 6.

The hard-of-hearing child. *The Laryngoscope*, Nov., 1931.

I. Modifications of the artificial larynx; II. Metal disks for permanent recording and reproduction of speech. *Transactions American Laryngological Society*, 1932.

Congenital deafness vs. deaf-mutism. *Sajous' Cyclopedia of Medicine. Problems of the Deaf*. St. Louis, 1932.

What have the teachers of handicapped children learned that all teachers should know. *Quarterly Journal Speech*, Feb., 1935.

The Acoustic Method for the Training of the Deaf and Hard of Hearing Child. St. Louis; *Laryngoscope Press*, 1939.

A S C A
News and Announcements

ERNEST H. HENRIKSON, *Editor*
University of Denver

Approximately 3,000,000 school children—from one to three in every schoolroom in the United States—have some impairment of hearing. Investigations reveal that the existence of handicapping hearing losses often is unsuspected by parents, teachers and even by the children themselves. The grave problem presented by these facts is one to which the late Dr. Goldstein, to whose memory this issue of the *Journal* is dedicated, devoted much of his time and rare wisdom, and it is for this most particularly that our Association honors him now. The leadership provided by Dr. Goldstein and other great humanitarians and scientists has made more and more meaningful and effective the vigorous and inspiring endeavors which so many of the deaf and hard of hearing themselves have for many years carried on in the interests of the acoustically handicapped. Their own organization, the American Society for the Hard of Hearing, is a heartening example of the will and the ability of handicapped individuals to fight their own battles.

Organized in 1919 and first known as the American Association for the Hard of Hearing, the American Society for the Hard of Hearing has grown until it now includes 120 chapters and 40 associated groups with a membership of 10,000. The Society has a permanent staff in Washington, D. C. which coordinates the nation-wide program. This program includes extensive activity in prevention and rehabilitation. The prevention phase of the program involves publicity, education, promotion of hearing tests and medical care. Rehabilitation covers education, employment, hearing aids, speech-reading instruction and social contacts. All these activities are carried out in active cooperation with the local chapters and with other groups, such as medical societies and children's bureaus, that are vitally concerned. The work of the Society has played a heavy role in stimulating an ever-increasing public interest in the deaf and hard of hearing, and in arousing the active cooperation with its program that is now being undertaken by our own Association, the American Academy of Ophthalmology and Otolaryngology, and other professional groups.

As one important evidence of this expanding activity on behalf of the acoustically handicapped, a new 16 mm. sound film, *The Right to Hear*, has recently been completed under the sponsorship of the Committee on Conservation of Hearing of

(Continued on Page 226)

A HEARING AID CLINIC[1]

B. H. SENTURIA, M.D.
Department of Otolaryngology, Washington University Medical School
S. R. SILVERMAN, Ph.D. and C.E. HARRISON, B.S.
Central Institute for the Deaf

With the increased use of hearing aids as prosthetic agents for those with impaired hearing, a marked need for an impartial evaluation of the comparative efficiency of such devices has arisen. Although recent advances in acoustic engineering have resulted in great improvement in the performance of hearing aids, the prospective user and the otologist are still confronted with the problem of selecting the most satisfactory instrument in any particular case from the many which are available.

In an attempt to shed light on the problem of evaluating hearing aids objectively and impartially in terms of the individual who is to use them, the idea of a hearing aid clinic was conceived by Dr. Max A. Goldstein. Accordingly, such a clinic was established at Central Institute for the Deaf and put into operation in September, 1941. It is the purpose of this paper to describe the operation of this clinic and to report preliminary findings regarding the performance of individual hearing aids in relation to specific categories of defective hearing.

During the past decade, numerous investigators have concerned themselves with the appraisal of hearing aids. Since responses to hearing aids vary according to the type of deafness, it was found necessary to establish appropriate classifications of deafness.

Halsted and Grossman (1) described four types of deafness: (1) middle ear conductive impairment, (2) inner ear conductive impairment, (3) abrupt high tone deafness and (4) deafness due to insufficiency of the acoustic nerve. Holmgren (2) simplified the classification into (1) conductive lesion, (2) cochlear deafness and (3) combined deafness. A modification of the latter classification used in this report employs the criteria for differential diagnosis outlined by Senturia and Thea (3).

One of the major obstacles in the adequate evaluation of hearing aids has been the lack of satisfactory testing equipment. In most reports the simple expedient of coupling the transmitter of the hearing aid to the ear piece of the audiometer has been utilized for appraising actual performance. This evaluative technique is scientifically incorrect, since it results in an acoustical mismatch and, in addition, fails to simulate the normal pattern of auditory communication.

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[1] The hearing aid clinic described in this paper was a project in which Dr. Max A. Goldstein was particularly interested immediately prior to his death. The article serves to summarize Dr. Silverman's contribution to the panel discussion on hearing aids at the annual convention of the American Speech Correction Association, Chicago, 1942. The authors wish to acknowledge the technical assistance of Mr. Alfred Thea, Miss Elizabeth Gorsuch and Miss Meredith Smith. The article is reprinted from the *Annals of Otology, Rhinology and Laryngology*, 1943, Volume 52, 131-146, by gracious permission of the Editors, L. W. Dean, M.D., and Arthur W. Proetz, M.D.

Berry (4) reviewed various methods available for testing aids and favored the test whereby the examiner reads and the patient changes his position and adjusts his aid until the distance is determined at which optimum hearing is obtained. Simple voice, word and sentence tests have also been used; however, control of intensity of the sound stimulus presents a troublesome variable in this technique. The Ewings (5) employed speech with the lips of the speaker thirty-six inches from the listener's better ear and with the aid at the same distance from the source of sound. The relative efficiency of these aids was considered first for vowels and then for consonants at various distances and intensities. Sabine (6), Knudsen (7) and others have also used standard intelligibility tests.

Holmgren (2), in his clinical approach to the problem, began with a complete otologic examination which included audiometric and loud speaker tests administered at a known and optimum noise level. From this information the selection of a hearing aid was made. The aid was then evaluated by means of intelligibility tests composed of nonsense syllables. In addition, the Kerridge (8) clinic provided for complete air and bone conduction tests in a specially constructed "sound-proof" room. At the conclusion of these tests a letter of instruction directed to the hearing aid agency was given the patient, and a seven-day trial of the recommended instrument was requested. No further follow-up evaluation was reported. Halsted and Grossman (1) supplemented the above technique by testing for above threshold intensities and sound distortion. Number, syllable and sentence tests for intelligibility with and without the aid were also administered.

Disagreement arose with regard to the extent to which the patient's opinion should be used as a criterion in the appraisal of an instrument. Berry (4) attached great importance to the judgment of the patient whereas Bunch (9), Fletcher (10), Knudsen and Jones (11), the Ewings and Littler (12) and Regers (13) stressed more objective valuation based upon thorough audiometric tests.

The amount of hearing loss has double significance both for the advisability of recommending an instrument and for the type of aid to be prescribed. Most authors were in agreement that cases with 30 to 40 decibel loss in the speech range require an aid only under unusual circumstances. In the range of 40 to 80 decibel loss the type of aid varies according to the shape of the audiometric curve. Fletcher (10) and Fowler (14) believed that if the aid were carefully designed, all these cases could be satisfactorily fitted.

In cases of losses from 35 to 60 decibels Holmgren (2) favored the use of the vacuum tube and emphasized the fact that little amplification might be expected from a carbon aid where the loss extended above 2500 cycles per second. On the other hand, Day (15) believed that a carbon type would perform satisfactorily with losses from 35 to 60 decibels, although favoring a vacuum tube type above and below these limits.

In the fitting of cases of severe deafness most workers reported poor results. Berry (4, 20) anticipated slight improvement in cases where the loss ranged from 80 to 100 decibels. Fletcher (10), Holmgren (2) and Kerridge (8) agreed that patients with losses greater than 110 decibels could not be helped.

Considerable disagreement appeared concerning the advisability of prescribing bone conduction instruments. Most workers felt, however, that low tone deafness could be assisted by such a unit. In these cases the high tones are filtered out by the skin and cranial bones and selective amplification of low tones is obtained. Bunch (9) and Hallpike (16), nevertheless, believed that the value of bone conduction aids has been

overemphasized and reported generally disappointing results. Kranz (17) and Berry (4) agreed that air conduction is of greater value in perception lesions, but the former believed that bone conduction yielded more satisfactory results in cases of mixed deafness. The Ewings and Littler (12) reported unfavorable results using a bone conduction unit with "practiced" cases of mixed and perception deafness.

Procedure and Apparatus

In the design, construction and operation of electro-acoustic aparatus to be used in measuring hearing with and without a hearing aid, careful attention to the efficiency and the accuracy of equipment is essential (18). The following is a description of the apparatus used in the Hearing Aid Clinic of Central Institute for the Deaf (Fig. 1).

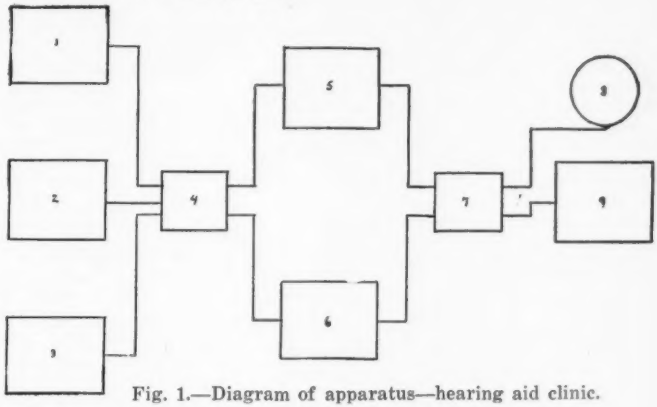

Fig. 1.—Diagram of apparatus—hearing aid clinic.

Legend:

Unit 1—WE 2A audiometer
Unit 2—ET reproducer
Unit 3—Microphone
Unit 4—Input selector switch
Matching equalizers
Unit 5—12 watt amplifier
Calibrated attenuation
Unit 6—30 watt amplifier
Calibrated attenuation
Unit 7—Output selector switch
Unit 8—Output volume indicator
Unit 9—Dual speaker system

1. The Western Electric 2A Audiometer was selected as a pure tone source because it is battery operated, it has stable frequency calibration, it has no hum, and there is less than one per cent harmonic distortion. Although it uses a compensated oscillator, the compensation was measured electrically and suitable equalizers were inserted in the circuit, so that the over-all characteristics are essentially uniform. Because of the mechanical characteristics of the ear piece supplied with the instrument, a special coupling transformer was devised which provided suitable compensation.

2. A special 30-watt amplifier unit was designed and constructed to provide sufficient amplification plus reserve power with less than two per cent distortion, as measured with a General Radio noise and distortion meter. Its frequency characteristics are linear, plus or minus one decibel from 60 to 10,000 cycles per second.

3. An electrical transcription turntable which revolves at either 78.24 or 33⅓ revolutions per minute and a reproducer with a dual speed motor are used. The reproducer is of the crystal type, imposing a needle pressure of 35 grams, and is mounted on a broadcast type reproducer arm which will handle records up to 17 inches in diameter. The reproducer is connected to the amplifier through a special equalizer, which possesses mirror characteristics to those used in recording the special test electrical transcriptions. Inasmuch as the transcriptions used were recorded in the Central Institute laboratories under ideal conditions, recording and reproducing characteristics could be accurately measured.

4. A dual speaker system was arranged by mounting two concert-type Jensen electrodynamic speakers in an appropriately designed cabinet which has adequate baffling to provide uniform response to 50 cycles per second. This baffle cabinet is a felt-lined acoustic labyrinth which utilizes back pressure to reinforce frontal radiation in the proper phase. The direct current field supply is obtained from a unit which forms an integral part of the speaker system.

5. The volume level indicator consists of a Weston 01 MA Meter with an 8-inch dial. The rectifier is of the copper oxide type and the attenuator is a constant impedance H pad arrangement, eliminating any reflection which might introduce phase distortion.

6. Calibrated attenuation with two intensity controls is provided, one control for the pure tone test and the other for the sentence test, electrical transcription. Dial markings are indicated so that all tests made with this apparatus are uniform. All alternating current wiring has been installed in conduit with a single master switch, further simplifying operation.

7. Phonograph records were discarded in favor of electrical transcriptions since the frequency range of the latter is much wider, varying from 100 to 9,000 cycles per second as compared with 150 to 4,000 cycles per second for the average phonograph record. An electrical transcription of the type used for these tests has a background noise of less than 55 decibels below recorded level, which is 25 decibels less than the newest type phonograph record. The transcription has four separate tests on one side, each test consisting of 25 selected sentences, carefully enunciated at a constant voice level by a professional announcer. This feature eliminates the need for changing records during the test.

8. The chair in which the individual is seated during the tests is located so that the ears and hearing aid are two meters from, and at right angles to, the calculated points of the source of sound.

9. The laboratory which houses the special equipment was selected because of its acoustical properties and average residual noise level. Reverberation time (time required for a 1,000 cycles tone to attenuate 60 decibels or to 1/1,000,000 of its original value) is one second, and the noise level averages 35 decibels above absolute threshold.

Clinical Procedure

The patient is first interviewed with particular attention to age, employment, children and previous use of hearing aids. The consulting otologist then records the complete anamnesis. In order to determine the exact loss by bone and air conduction in each ear, the first step in actual testing is the pure tone audiometer test using both air and bone conduction receivers. These tests are carried out in a relatively quiet room. The patient is then tested with the apparatus previously described in a room with reverberation characteristics which simulate those of the average living room. The pure tone and sentence

tests employing the loud speaker are then administered to the unaided ears. The test is repeated using the hearing aids to be evaluated. After the amount of improvement with each aid is recorded and studied, recommendation is made which favors the aid or aids exhibiting the most satisfactory characteristics in terms of the patient's responses.

At all sessions of the clinic a qualified educator of the hard of hearing, familiar with the psychological and pedagogical problems faced by those with impaired hearing, is available for consultation. It is his function to make recommendations for lip reading and acoustic training after the aid has been purchased, since this type of education is necessary if optimum benefit is to be derived from the use of the instrument. The personnel of the clinic thus includes a consulting otologist, trained audiometrists, an acoustic engineer and an educator of the hard of hearing.

RESULTS

The results of this investigation lend themselves to convenient presentation if they are considered according to the following classifications of impaired hearing:

1. Conduction deafness is characterized by normal or slightly decreased bone conduction, negative Rinne and a normal or retracted tympanic membrane. Many of these cases are classical examples of otosclerosis while the remainder are diagnosed as hyperplastic otitis media.
2. Mixed deafness is characterized by early perceptive lesions in association with middle ear disease.
3. Perception (nerve) deafness is characterized by a marked reduction in air and bone conduction.

Of more than 100 cases examined during the period of operation of the clinic, 75 unselected cases are reported. Of these, 19 were found to be conduction deafness, 29 mixed deafness, and 17 perception deafness. The results in 10 cases showed a loss greater than 110 decibels in the speech range and no attempt was made to prescribe an instrument.

Thirteen different aids, most of which have been accepted by the Council of Physical Therapy of the American Medical Association (19), including various models produced by seven manufacturers, were available to the clinic for evaluation. The instruments mentioned in the present report are designated by letters of the alphabet with subnumerals indicating different models of the same manufacturer. A sampling of ten cases from each category of deafness is reported in detail. Tables 1, 2, and 3 indicate that certain aids were used more frequently than others. This was due to the greater availability of these particular instruments.

Conduction Deafness. Examination of the cases of con-

duction deafness in Table 1 indicates that a maximum improvement of 30 decibels at various crucial frequencies was obtained. Only in isolated instances, in each case limited to a single frequency, was a greater improvement demonstrated. It is evident that individual instruments vary widely in performance. In many cases comparison was made between the aid worn by the patient when he came to the clinic and the instruments which were permanently available. An example of the striking contrast between two instruments can be noted in cases No. 2 and No. 3 where aids A2 and F2 were appraised.

TABLE 1. CONDUCTION DEAFNESS

Case	Instrument	Type	Gain in Decibels at Specific Frequencies				
			256 c.p.s.	512 c.p.s.	1024 c.p.s.	2048 c.p.s.	4096 c.p.s.
1.	A1	Air	10	15	10	10	10
	B1	Air	20	15	35	−5	10
2.	A2	Bone	30	10	20	25	20
	F2	Bone	15	0	−5	25	15
3.	F2	Bone	0	−5	−5	10	0
	A2	Bone	30	15	25	25	25
4.	A2	Bone	5	15	15	5	0
	B1	Air	5	5	20	10	0
	B2	Air	5	10	20	10	20
5.	A1	Air	10	20	20	20	20
	B2	Air	0	5	10	5	10
6.	A2	Bone	20	25	30	15	5
	A1	Air	10	10	20	20	5
7.	A1	Air	10	15	5	5	0
	A2	Bone	15	15	5	5	0
8.	A1	Air	0	20	10	35	5
	F1	Air	5	10	15	20	10
9.	A2	Bone	−5	10	20	10	0
	A1	Air	0	0	25	15	15
10.	B1	Air	10	20	30	10	5

c.p.s. Cycles per second.
−Loss in amplification with instrument.

Consistently superior performance was observed not only in the amount of amplification, but also in the range of frequencies amplified where aid A2, with a bone conduction unit, was used. Different instruments varied with regard to the frequency at which maximum amplification was obtained. Instruments B1 and B2 showed consistent "peaking" at 1024 cycles per second and aid F2 seemed to achieve greatest amplification at 2048 cycles per second.

Mixed Deafness. Examination of Table 2 indicates that in cases of mixed deafness, a generally uniform gain of from 25 to 35 decibels was noted with occasional gains of from 35 to 45 decibels at single frequencies. Most of the instruments yielded improvement in the frequencies from 256 to 4096 cycles per second with an occasional exception, as case No. 1, using aid

A1, and case No. 2, using aid E2, illustrate. Variability in performance by the same instrument in different cases of the same type of deafness was observed. For example, aid A1 in case No. 1 yielded no gain but the same instrument used in case No. 4 provided substantial amplification. In cases where bone conduction units were tested appreciable gains in the range from 256 to 2048 cycles per second were noted. No significant increase in amplification with these units was observed at 4096 cycles per second. Aid A1, an air conduction instrument, showed consistent "peaking" from 1024 to 2048 cycles per second.

TABLE 2. MIXED DEAFNESS

Case	Instrument	Type	Gain in Decibels at Specific Frequencies				
			256 c.p.s.	512 c.p.s.	1024 c.p.s.	2048 c.p.s.	4096 c.p.s.
1.	A1	Air	−10	0	0	−5	−5
2.	A1	Air	15	10	30	20	0
	E2	Air	0	5	10	−5	−20
3.	A1	Air	5	10	15	20	5
	C1	Air	5	15	10	20	5
4.	D1	Air	25	20	15	20	10
	A1	Air	35	15	40	45	30
5.	A2	Bone	20	20	30	30	0
	C2	Bone	25	25	30	30	0
6.	B2	Air	5	10	20	25	5
	A1	Air	20	20	20	30	15
7.	B1	Air	0	0	10	20	15
	A1	Air	35	30	25	15	15
8.	F2	Bone	10	15	0	10	0
	A2	Bone	20	20	15	30	5
9.	D1	Air	10	30	35	10	0
	A1	Air	10	30	20	15	0
10.	A1	Air	−5	5	20	20	0
	F1	Air	0	−5	5	0	0

c.p.s. Cycles per second.
−Loss in amplification with instrument.

Perception Deafness. In the cases of perception deafness shown in Table 3 a maximum amplification of from 30 to 35 decibels, restricted in most instances to the range from 256 to 512 cycles per second, was obtained. In the remaining frequencies little amplification was observed, although beneficial results prevailed in some instances, e.g., cases No. 5, using aid B2, and No. 6, using aids A1 and B1. No consistent "peaking" was observed.

The evaluation of aids on the basis of responses to the pure tone audiometer was supplemented by appropriately selected sentence tests in most of the cases (Table 4). It was significant that in some cases a gain of only 10 decibels throughout the range from 256 to 2048 cycles per second yielded from 25 to 50 per cent increase in sentence intelligi-

bility. In the few instances where bone conduction units were evaluated by the sentence tests, a beneficial increase in intelligibility was observed (as in case No. 2, using aids A2 and B2). In two instances where there was lack of response to the sentence test with the unaided ear, there was from 48 to 100 per cent improvement with the instrument. Additional data concerning the appraisal of hearing aids by means of the sentence intelligibility technique are being gathered.

TABLE 3. PERCEPTION DEAFNESS.

Case	Instrument	Type	Gain in Decibels at Specific Frequencies				
			256 c.p.s.	512 c.p.s.	1024 c.p.s.	2048 c.p.s.	4096 c.p.s.
1.	A1	Air	0	5	0	10	−20
2.	A1	Air	0	15	5	0	−5
3.	A1	Air	25	10	15	15	NR
4.	G1	Air	30	25	NR	NR	NR
	A1	Air	35	35	NR	NR	NR
5.	D1	Air	30	15	20	−15	5
	A1	Air	20	15	10	−5	0
	B2	Air	25	30	30	10	5
6.	B1	Air	−5	−5	30	20	15
	A1	Air	−5	0	50	10	20
	B3	Air	−15	−20	10	0	−15
7.	A1	Air	0	10	NR	NR	NR
8.	A1	Air	−5	10	5	25	10
	A3	Air	5	5	5	NR	NR
9.	A1	Air	5	15	15	NR	NR
10.	A1	Air	5	10	25	0	0

c.p.s. Cycles per second.
NR No response with instrument.
−Loss in amplification with instrument.

DISCUSSION

The functioning of the Hearing Aid Clinic at Central Institute for the Deaf demonstrates the possibility of evaluating hearing aids scientifically and impartially in a clinical atmosphere. Although the limitations of clinical operation preclude the possibility of testing every aid with every patient, multiple testing is being carried on in selected cases, the results of which will be reported in a subsequent publication.

Although the usual air and bone conduction audiometric tests are made under relatively quiet conditions, the room in which the hearing aid evaluation takes place simulates average living room acoustical conditions, both as to noise level and reverberation characteristics. True appraisal of an instrument can be made only under such conditions.

The patient's subjective judgment as to the advisability of a particular aid is either corroborated or altered by the objective character of the intelligibility and audiometric tests. Hence, because of the availability of facts presented without

TABLE 4. COMPARATIVE GAIN WITH HEARING AID ON PURE TONE AND INTELLIGIBILITY TESTS

Case	Instrument	Type	Type of Deafness	Gain in Decibels at Specific Frequencies			Percentage Score of Intelligibility Sentences	
				512 c.p.s.	1024 c.p.s.	2048 c.p.s.	Without Aid	With Aid
1.	G1	Air	Conductive	20	20	10	44	84
2.	A2	Bone	Conductive	15	15	5	52	88
	B1	Air	Conductive	5	20	10	N.T.	84
	B2	Bone	Conductive	10	20	10	52	84
3.	A1	Air	Conductive	10	5	5	44	76
4.	A1	Air	Mixed	10	5	5	84	100
5.	A1	Air	Perceptive	10	10	25	60	100
6.	A1	Air	Mixed	10	30	20	N.T.	83
	E2	Air	Mixed	5	10	−5	N.T.	46
7.	D1	Air	Mixed	20	15	20	0	0
	A1	Air	Mixed	15	40	45	0	48
8.	A1	Air	Mixed	20	30	30	0	96
	C2	Bone	Mixed	25	30	30	0	100
9.	A1	Air	Conductive	20	20	10	76	100
	B2	Air	Conductive	5	10	5	N.T.	N.T.
10.	A2	Bone	Conductive	5	20	25	60	96

c.p.s. Cycles per second.
N.T. No test performed.

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prejudice, psychological resistance to an instrument is reduced to a minimum. The amount of amplification obtained in fitting aids varies with the type of deafness involved. Cases of conductive deafness presented comparatively little difficulty in fitting, and, although the maximum improvement in most cases was limited to 30 decibels, the gains occurred at those frequencies necessary for optimum intelligibility of speech.

Optimum results were observed in cases of mixed deafness with consistent improvement of from 25 to 35 decibels. Although this amount of improvement is less than that noted in cases of perception deafness, the amplification was spread over a wide frequency range, while in the latter group the improvement was restricted to a very narrow portion of the lower frequency band. Amplification of extraneous noises which dominate the lower portion of the frequency spectrum results in the masking of those tones, the hearing of which is essential for intelligibility of speech. Although some instruments are purportedly constructed for the suppression of these low tones, in practice their performance fails to measure up to the claims of the manufacturers. The problem of successfully fitting cases of perception deafness remains a challenging one.

It is important to note that in many cases a slight gain in amplification through the use of a hearing aid, as recorded on the pure tone test, results in a greater proportionate improvement on the sentence intelligibility test. This undoubtedly occurs because enough gaps in the auditory pattern are filled to enable the patient to bring into play his ability to synthesize the language stimulus into a meaningful whole. It is possible, therefore, that a gain of as little as 10 decibels may be sufficient to bridge the gap between intelligibility and unintelligibility of speech. The need for the development of the ability to integrate auditory language stimuli emphasizes the importance of a period of acoustic training for those who are in the process of adjusting to a newly acquired hearing aid.

SUMMARY

1. Specially designed equipment and a clinical procedure for evaluating hearing aids impartially and scientifically are described.

2. The desirability for cooperation among the consulting otologist, the acoustic engineer, the educator of the hard of hearing and the hearing aid manufacturer is emphasized.

3. An unselected series of cases of impaired hearing, classified according to type of deafness, was examined and tested for hearing aids in the clinic.

4. Thirteen different hearing aids, including various models produced by seven manufacturers, were evaluated.

5. Results may vary according to the instrument tested,

according to the type of deafness, and within any category of deafness.

6. In cases of conduction deafness a maximum improvement of 30 decibels in the speech range is reported. Bone conduction units are superior in some instances and air conduction aids are better in others. The results do not warrant a generalization as to the type of aid to be prescribed in these cases.

7. In cases of mixed deafness a general gain of 25 to 35 decibels in the speech range is noted. Optimum results are indicated for this type of deafness.

8. In cases of perception deafness a maximum improvement of 25 to 35 decibels within a limited frequency range is observed. Cases of extreme deafness cannot be fitted adequately with a hearing aid and they remain a challenging problem.

9. A slight increase in hearing with an aid as measured by a pure tone test may result in a greater proportionate increase in intelligibility. This is due to the fact that gaps in the auditory pattern are filled, facilitating synthesis of auditory language stimuli.

10. A period of acoustic training is desirable after the acquisition of a hearing aid.

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NEWS AND ANNOUNCEMENTS

(Continued from Page 214)

the American Academy of Ophthalmology and Otolaryngology, of which Dr. Dean M. Lierle is chairman. It was produced by the Bureau of Visual Instruction, Extension Division, State University of Iowa, under the direction of the Department of Otolaryngology and Oral Surgery of the University of Iowa College of Medicine, with the cooperation of the Department of Speech. The picture dramatizes the need for organized programs of conservation of hearing and emphasizes the objectives and possibilities of attainment in a carefully planned approach to the problems involved. The film suggests many of the details for organizing a conservation of hearing program. Nation-wide showing of the picture is planned by the Committee on the Conservation of Hearing. A descriptive folder presenting details about this film is published by the Extension Division of the State University of Iowa.

Further evidence of increased attention to the problems of the deaf and the hard of hearing is shown in the expanded offerings being presented by a number of training centers for teachers. An example of this is the Symposium in the Teaching of Speech Reading offered as a part of the program in the Education of the Deaf and Hard of Hearing at Northwestern University during the past summer. The symposium included a "series of lectures on problems facing handicapped persons, systems of lip reading, and methods for teaching speech reading to children and adults." These lectures were supplemented by demonstrations, discussions and readings. In college and university speech pathology programs throughout the country hearing problems are receiving increased attention.

Legislative action establishing or enlarging facilities for caring for handicapped children continues. An example is Senate Bill No. 135, passed without opposition in the State of

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HISTORY AND PRESENT STATUS OF THE EDUCATION OF THE HARD OF HEARING

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I.

The history of the education of the hard of hearing in the United States must necessarily begin with the interests and inventions of Alexander Graham Bell. His early efforts to utilize the phonetic principles of his father's book to teach speech to the deaf were consummated on the day many years later when all schools of the United States taught deaf pupils wholly or in part by the oral method. His discovery of the telephone introduced principles that have been utilized not only to create a net-work of communication throughout the world but also to give hearing and speech to the deaf and hard of hearing. Founding the Volta Bureau in 1887 and the American Association to Promote the Teaching of Speech to the Deaf in 1890, he furnished the medium to educate the public by assembling and distributing information on the problems and needs of the acoustically handicapped. The Bureau's official publication, *The Volta Review*, has recorded the medical, educational, scientific and social growth in training the deaf and hard of hearing.

II.

In addition to fostering the movement of teaching speech to the deaf the Bureau quickly sensed the need for teaching lip reading to the hard of hearing. During the nineteenth century, adults in the United States observed that deaf children could read lips of speakers. The very young deaf child can be taught to understand some speech of its elders. At school, he formally learns to read speech in the form of instructions, commands and symbolic objects before he can produce a single speech sound. Training in the production of vowels and consonants supplemented by language instruction, together with grammar, vocabulary and experience, supplies the deaf person with the tools of oral communication. This formal program may proceed without a single mention of the term "lip reading."

Until the beginning of the present century the only teachers available to hard of hearing adults in the United States were the teachers of the deaf. Seeking a teacher of the deaf shortly before 1900, was Miss Martha E. Bruhn, a young language teacher in Boston schools who was losing her hearing. She was informed by friends that Julius Müller-Walle in Germany had devised in 1875 a method of teaching lip reading to adult hard of hearing persons. After training under Müller-

[1] President of the American Society for the Hard of Hearing.

Walle, Miss Bruhn introduced his method in this country and is still a leading teacher of lip reading.

Edward B. Nitchie, a pioneer in lip reading, gained high honors from Amherst College in 1899, although he heard only by aid of an ear trumpet. He studied lip reading at a newly opened school of Miss Lillie Edgington Warren in New York City. He later became Miss Warren's assistant but in 1903 opened a school and devised his own methods of teaching lip reading.

Teachers trained by these and other pioneers of lip reading opened classes in other cities. Although lessons were given to one person at a time, students of the teachers formed social and practice groups which were known as leagues, guilds or speech-reading societies. The first of these groups, the Nitchie Service League, was formed in 1910, and later renamed the New York League for the Hard of Hearing. It early granted scholarships to hard of hearing adults and through subsequent years became the largest league in the world for the hard of hearing, offering to its community a variety of services, industrial, educational, welfare, and employment. In 1913, two evening classes to teach lip reading to adults were opened in the schools of New York and Brooklyn. The latter was taught, in 1913, by Miss Estelle E. Samuelson at the suggestion of Mr. Nitchie, her teacher. In 1915, the first public school classes in lip reading for children were opened in Lynn, Massachusetts, and Rochester, New York. In 1927, Miss Bruhn published the first textbook on lip reading for elementary school children.

By 1919, groups in eight other cities were pioneering for the hard of hearing in a manner similar to that of the New York League. In this year, certain events occurred which signalled the beginning of a new epoch in the education of the hard of hearing. Returning soldiers, deafened by war casualties, needed rehabilitation. The hard of hearing societies had already been rehabilitating lives of civilian handicapped. In order better to facilitate the guidance of the soldiers and civilians, Dr. Wendell C. Phillips proposed that the nine societies unite as the American Association for the Hard of Hearing, which later became the American Society for the Hard of Hearing. Its purposes were "(1) to act in the national and international fields of social work for the deafened; (2) to encourage the founding of local organizations; (3) to spread national propaganda in the interests of the deafened and in the prevention of deafness." Acting as a national organization, the society proclaimed itself as sponsor and defender of the hard of hearing, and was in a position to collaborate with national social and educational organizations. In 1920, Congress provided for the vocational rehabilitation of disabled persons in order to return as many as possible to employment. Since

that time, the American Society for the Hard of Hearing has acted as counsel and collaborator in many governmental matters concerning the hard of hearing.

III.

The year 1919 had significance also because the concerted action of the newly formed association members brought together three great groups who have contributed substantially to the development of conservation of hearing in the United States. On the one hand was the educational and social service group, The American Society for the Hard of Hearing, first national organization of handicapped persons banded together to help themselves. Today the society has 120 active and 40 potential chapters and 7,000 members. It has been largely responsible for the social, industrial and educational improvement of the status of the hard of hearing. On the other hand, there were the medical and scientific groups of workers. Pioneering work on audiometers in the United States by Seashore as early as 1897 and later by Bunch and Dean[2] afforded a preview of the use of such equipment for clinical practice. Amplification of sound by means of radionics and long distance telephony gave researchers more intimate access to the psychology and physiology of hearing. Publications of Fletcher, *Speech and Hearing*, and Miller, *Science of Musical Sounds*, and others prefaced the large volume of researches performed in medical schools and university and industrial laboratories. Summaries of these researches by Stevens and Davis in *Psychology and Physiology of Hearing* reveals the scientific developments that paralleled the historic work of the American Society for the Hard of Hearing. Analysis of the 347 references listed by Stevens and Davis revealed that 23 (6%) were published between 1863 (Helmholtz) and 1920; that 55 (16%) appeared between 1920 and 1930; and that 269 (78%) of the researches were reported between 1930 and 1938.

The great surge of research on hearing and speech was facilitated, as mentioned above, by the practicality of amplifying sound by means of the radio tube and devices used in long-distance telephone communication. Hence when the American Society for the Hard of Hearing asked for help in constructing an instrument for testing large numbers of school children, Harvey Fletcher, of the Bell Telephone Laboratories, and Dr. Edmund Prince Fowler, internationally-known otologist, and their staffs collaborated to produce a group testing instrument known today as the phonograph audiometer. It had been preceded by several years by various forms of a pure tone audiom-

[2] Seashore evolved an audiometer in 1897 and tested the hearing of pupils in Iowa City, Iowa, in 1898. In 1919 Bunch and Dean reported the use of the pitch range audiometer in otology.

eter. When a Committee on Hard of Hearing Children was appointed in 1924 by Dr. Gordon Berry, then president, at the suggestion of Dr. Wendell C. Phillips, the Society officially began an educational campaign for the adoption of the group audiometer. In 1928, Mrs. James F. Norris, chairman of the Children's Committee, reported 125 audiometers were in use and that 19 cities reported testing 180,000 children. In 1933, Miss Ena Macnutt, the new chairman, reported returns from 45 cities and 22 states. A total of 491,321 children were tested. For the school-year, 1939-1940, Warren H. Gardner, chairman of the Committee, summarized reports from 780 towns and 110 counties in 36 states and Hawaii. Audiometer tests were given to 3,173,089 children. A larger number than this are actually being tested. One manufacturer reported to the writer that over 1,500 phonograph audiometers had been sold up to 1943 and 1,300 were probably in use. Since the last report by Gardner, compulsory hearing tests have been legislated in Indiana and Washington. Expanded testing programs are proceeding in other states under auspices of state departments of education and state boards of health. The most recent development has been the employment of hearing consultants in the Division of Maternal and Child Health of state boards of health (Oregon, 1940; Michigan, 1942; California, 1943).

The incidence of hearing deficiency, as determined by audiometer tests, has been the subject of much debate. The early tests were given under trial and error methods and without adequate understanding of testing conditions and criteria. In recent years, adequately trained personnel in numerous cities have given more stability and reliability to the testing procedures, so that later figures point more closely to the true incidence of hearing loss among school children. Gardner's report on the school year, 1939-1940, indicates that 4.9 per cent of 947,471 unselected pupils were deficient on two tests of the group audiometer, using 9 db. loss as a criterion. One in ten of 44,980 unselected pupils tested by pure tone or pitch audiometers was deficient. Again untrained testers and lack of suitable criteria have placed the more recent testing by pitch audiometer in the same position as the experimental days of the group audiometer. However, very careful tests by the pure tone audiometer indicate that a larger percentage of the true hearing deficiencies is found by this instrument than by the phonograph.

IV.

The annual committee reports and conferences of the American Society for the Hard of Hearing have been an index to the gains made in education and conservation. In the field of the adult deafened, eighty-five societies for the hard of hearing provide lip reading practice classes and sixty-three pro-

vide instruction classes. Ninety-two of the societies own group hearing aids which are used for recreational and training purposes. Fourteen societies have employment bureaus and twenty-nine others give vocational guidance. Many of the societies were organized by teachers of adult lip reading who were trained by teachers in the older societies, or who received teacher-certificates from lip reading schools. Thus grew a profession of teachers of lip reading to adults, as the conservation program spread throughout the land. These people have carried the heavy task alone, as they strived to rehabilitate the adult who was suddenly deprived of his hearing.

Annual reports by the Committee on Hard of Hearing Children reveal the growth in education for these children. The Committee reported in 1928 that 22 cities were giving lip reading to hard of hearing children. In 1933, 65 cities in 25 states and Washington, D. C. enrolled 4,277 children in public school lip reading classes. In the report for the year, 1938-1939, 257 teachers in 107 reporting towns were giving lip reading to 17,708 children. By tabulating returns over a period of years, the writer finds that over 200 cities had reported giving lip reading lessons to approximately 20,000 children. This is a great gain in the period of fifteen years reported by the different chairmen of the Children's Committee. However, the total number of children needing lip reading in the United States is much larger. The Department of Lip Reading of the National Education Association reported in *The Lip Reader*, February, 1939, the results of a questionnaire survey on subjects pertaining to lip reading. It reported that the percentage of total enrollment of school children who received lip reading in individual cities was an average of 1.7 per cent and a median of 1 per cent. On the basis of 1 per cent of 30,000,000 school-age children, over 300,000 should be receiving lip reading instruction in all states.

In Maine, a grade teacher in each town may be selected to obtain special training in order to service with lip reading instruction all children with a hearing loss in her building. In Wisconsin, all speech correction teachers are required to train for lip reading instruction. In other states and cities lip reading lessons are given only as the conservation program is developed and as officials become informed concerning the need of furnishing extra-curricular assistance. In many cities, the obviously deafened alone receive lip reading, and this in the residential or day schools for the deaf.

In Gardner's survey of the 1938-1939 school year, 33 cities reported they were training 1250 hard of hearing pupils in centralized classes. Some of these classes are in the day schools for the deaf where economy of administration does not permit instruction of the hard of hearing separately or in their own

buildings. Day schools for the deaf are increasing in number yearly. In 1887 there were 48 residential schools for the deaf and eight day schools with populations of 7,463 and 347, respectively. In 1936 there were 65 residential and 124 day schools with populations of 14,249 and 4,396, respectively.[3] Gardner also found in the 1938-1939 survey that 74 cities reported giving lip reading instruction to children in their own buildings. Insufficient information is available to report the total number of peripatetic lip reading teachers, or the number of cities in which children are required to come to central buildings once or twice a week for lip reading instruction. The prevailing opinion of educators of exceptional children is that the hard of hearing child should be kept with the normally hearing and be temporarily withdrawn from the classroom only to the extent that special training is necessary.

Special assistance for the hard of hearing child varies with the school personnel that is available, with the generosity of school directors and with the information that these persons possess concerning the great need of the handicapped children. Sixty-eight cities recently reported to the writer a variety of special services extended to the hard of hearing child who is not holding his own in grade subjects. Seven cities give lip reading only. Eight give him a special seat but no lip reading. Seven give him a special seat and lip reading. Six give him assistance in grade subjects but no special seat or lip reading. Fourteen cities give lip reading or special seating plus school or private tutoring. Twenty-five schools use one or more of the following methods:

1. Additional help such as special attention by teacher.
2. Advise private lip reading lessons.
3. Seek private tutoring on deficient subjects.
4. Individual coaching by teacher.
5. Remedial reading.
6. Speech correction.
7. Cadet helper.
8. Readjustment of methods of instruction to pupil's problem.

It is noteworthy that none of these twenty-five cities offered lip reading, although their hard of hearing pupils were not holding their own in grade subjects. One school system reported that adjustments were made according to the particular problems of the pupils. These adjustments consisted of lip reading lessons, special seats, definite effort of teacher to see that pupil understands her, tutoring by unassigned teacher individually or in small groups, vocational guidance, individual or group hearing aids, and lip reading correlated with class subjects when groups are small.

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[3] Harris Taylor. Public day schools for the deaf in the United States, *Volta Review*, 1937, 39, 329.

V.

The use of hearing aids, individual or group, in education of the hard of hearing has become more popular as technical problems of manufacture have been solved, as appreciation of their value in training residual hearing has grown, and as techniques and methods of instruction have been developed. There is no general agreement on the age at which a child can wear a hearing aid or the amount of benefit to be obtained from it. Twenty cities reported to Gardner that sixty children were wearing individual hearing aids in the school year, 1938-1939. No mention was made of ages or of special assistance given to them. The writer knows of several first-grade children who wear individual hearing aids and several others who use the desk-type (Zenith Ravox). In all of these cases the children have had to receive supplemental guidance in the form of lip reading, remedial reading, speech correction and language development. Several high school students have immediately improved in their grade subjects after listening through an individual portable or desk-type aid.

Although manufacture of group hearing aids began shortly after radio amplification became practical, their acceptance as educational devices was slow because of imperfections in operation and in reproduction of speech sounds. However, as with other phases of hearing work, acceptance speeded up in the last decade. The Central Institute for the Deaf first used a group electrical hearing aid in 1921. The Committee on the Use of Residual Hearing of the American Association to Promote the Teaching of Speech to the Deaf, reported as of January, 1936, that of the 132 residential, day and private deaf schools who returned questionnaires, 88 schools reported ownership of 172 group hearing aids, 39 of which were purchased prior to 1933. These aids had 556 receivers. They also reported that 123 pupils owned individual hearing aids. The State School for the Deaf at Jacksonville, Illinois, today has a separate building for all children who can profit from instruction by this method. As soon as children are properly trained in the use of a hearing aid, have acquired sufficient training to permit a return to the public school, and if the parents can provide an individual aid, the children are released from the state school. Gardner's survey for the school-year, 1938-1939, showed that 21 public school systems were giving instruction to 618 children by means of group hearing aids.

The most important use of the hearing aid is mind-training. Although educators of the deaf had realized for many years that some of their children were not completely deaf, and took advantage of this in training them with speaking tubes and other devices, definite information was lacking until the audiometer was introduced. Then it was found that scarcely

20 per cent of children in schools for the deaf have complete loss of hearing and that not more than 40 per cent have deficiencies greater than 75 per cent. But the audiometer tests in public schools revealed a startling number, an entirely new group, of children with hearing deficiencies that often proved handicapping in school achievement. Children who are born with low hearing, or acquire a partial loss before reaching the developmental period for speech, may acquire speech and language that approaches the normal in relation to the degree of loss, the type of hearing curve and the amount of training of residual hearing and exposure to good language by means of a hearing aid. The writer frequently finds children in public schools with 30 to 50 per cent losses in hearing who have very little comprehension of language meaning and are severely defective in speech. He finds many other children with lesser losses in hearing who are retarded in speech and reading and often are personality problems. Teachers have attributed their deficiencies to low mentality and have ignored them in deference to the normal members of their classes. The writer has seen startling improvement in accuracy and use of speech and language, and reversals in social responses of such children through training in the use of their residual hearing for varying priods of time. Space does not permit discussion of a program for residual hearing other than emphasizing the great importance of utilizing the hearing of every child in order to enable him to speak, act, think and achieve as effectively as his trained psycho-physiological mechanisms permit.

VI.

The hearing aid is an important device of the teacher of speech. No speech department, or university, or psychological clinic should be without a pure tone audiometer and a hearing aid of a group or individual type. These instruments represent one of the many refinements in teaching speech that have been utilized as a result of modern researches and pioneering efforts that parallel in time the history of the education of the hard of hearing child. Even as instruction in lip reading and giving speech to the deaf in this country stemmed from the intense interests of Alexander Graham Bell, so were phoneticians moved by his *Visible Speech* (1867) to develop a scientific, standard means of representing normal speech production that could be universally understood. The surge of researches on the science of speech and correction of defects centered around the nature, theory, classification and incidence of speech defects. Early administrators of routine corrective exercises took for granted that the speech defects were functional, until psychological and educational tests and later medical examinations revealed the need of exploring all factors that might

cause a deviation from the normal. Thus, speech clinics became speech and hearing clinics when audiometer tests revealed that many so-called aphasics were deficient in hearing, that the pathology of cleft-palate cases contributed to hearing deficiencies, that numerous cases of cerebral palsy had low hearing acuity. It was learned by experience that occasional cases of articulatory defects which appeared to be functional involved loss of acuity in those areas of hearing that permitted perception of specific speech sounds. It was necessary to re-educate the speech of these children by aid of amplifiers. Today, some traveling speech correctionists and remedial reading teachers carry with them portable hearing aids (Ravox type).

Psychological and speech and hearing clinics have amplifiers for individual or group instruction. Clinicians have found that a hard of hearing child will have better articulation with a hearing aid than without. They find, as does the writer, that the speech-defective child, who has normal hearing, will reproduce more faithfully speech that is presented to him through an amplifier than by the unaided voice. Hence, preparatory courses for teachers of speech correction include courses in the nature and psychology of hearing, causes and types of hearing defects, training of residual hearing and lip reading. Every child who has a speech defect is examined for loss of acuity in hearing, as well as for numerous other deviations that are so frequently associated with abnormal conditions.

Re-education of voice and speech of the adult hard of hearing is today carried on by the modern speech pathologist. In the first two decades of this century, members of the pioneering groups of lip readers were trained by what were then called teachers of elocution. Good speech was attained by the reading aloud of good literature. Scientific research has in recent years made available to adults the same speech re-education that is now being administered to children in thousands of schools throughout the nation. The modern sciences of speech and hearing re-education have developed side by side over the same period of time. Researches in each have facilitated progress in the other. Today the hearing expert must be a speech pathologist and the speech correctionist must be an expert in fundamentals of hearing, and both must be clinical psychologists.

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MEMO

The story of the death of Lt. James Maddox, summarized in War Notes in the June issue of the *Journal*, is told in a series of three articles by Mark Murphy in the *New Yorker*. The first article of the series appeared in the issue of August 21, page 26.

AUDIOMETRIC TESTING AND HEARING CONSERVATION IN THE PUBLIC SCHOOLS[1]

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I.

The subject courteously assigned me by your program committee is too comprehensive to be covered at this time and place. I shall limit my statements to certain facts related to a neglected problem; namely the conservation of hearing during the school age.

Hearing impairment is largely a matter of impaired health. Planned school health education with the early application of preventive and corrective measures during school life is a large factor in the attainment of higher national health standards. The inclusion in the expanding school health program of an organized plan for periodically testing the hearing acuity of all pupils by approved methods has made the school potentially the most important unit for the conservation of hearing. This procedure has been put in operation by special legislation as a definite feature of the state school health program in several commonwealths including New York, Pennsylvania, Oregon, Indiana, Washington and California,[2] and is used independently without compulsion or benefit of legislation in an increasing number of communities.

The surprisingly high incidence of significant hearing impairments among school children and the great benefit resulting from the early discovery, when followed by prompt corrective care, have been demonstrated in recent years by the mass-testing of the hearing of millions of pupils by modern methods. It should be emphasized that the objective of these tests is to disclose not only those who already have recognized or suspected hearing handicaps, but what is of greater importance, to discover the larger number of pupils who have slight, often subjectively unnoticed but potentially handicapping hearing deficiencies, in order that they may be given corrective medical care and educational adjustment at the time in life when treatment is most effective. Thus the early discov-

[1] The subject matter in this paper was presented largely in its present form before the American Academy of Ophthalmology and Otolaryngology at its 47th Annual Session in Chicago, October 11, 1942 and was published in the *Transactions of the Academy*, March-April, 1943, pp. 319-321. The paper as presented here was read in substantial part before the American Speech Correction Association, Chicago, December 29, 1942. Dr. Newhart has served as chairman of the Committee on the Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology.

[2] Two excellent bills for the conservation of hearing have been enacted in California since May 30, 1943.

ery of hearing deficiencies during the school age is the first step in the prevention of avoidable hearing impairment on a comprehensive scale.

Unfortunately the almost universal unfamiliarity with the elementary principles involved in carrying out this program, a lack of uniformity of procedure, standardized technics and criteria, a shortage of trained personnel and often the inadvertent use of inaccurately calibrated equipment have seriously delayed the more general adoption of the periodic audiometer testing of the school population in unselected groups.

To correct this unsatisfactory condition there is urgent need for a practical, economical, standardized state program for protecting the hearing of school children. This need is rapidly becoming more obvious to otologists, educators and especially to speech pathologists who recognize the frequent relationship between impaired hearing and certain speech defects.

II.

Serious consideration is being given by the American Academy of Ophthalmology and Otolaryngology through its Committee on the Conservation of Hearing to the formulation of a model state program which will include the minimum essential provisions and with adaptations can be modified to meet the needs of different states.[3] In simplified form it can be used in urban and rural school units where a state program is not in operation.

A state plan for the detection and care of hearing deficient school children promises the greatest degree of success when the responsibility for its administration is delegated by legislative enactment jointly to the State Board of Health and the State Board of Education working in the closest cooperation. These agencies must have the understanding collaboration of the medical profession and educational officials to insure the most satisfactory results. The functions of each group are distinct but closely related. The State Board of Health will establish the necessary standardized technics for the discovery of hearing deficiencies and their interpretation; also the procedures to be recommended for securing the best corrective medical care of pupils found to have existing or potential hearing impairment. This last function must be performed without invading the private practice of medicine, nevertheless insuring that the hearing deficient child shall receive the care of a licensed physician qualified to render expert otological service. The children of parents in the lower income brackets must be provided with equally skillful care through local and state welfare and clinical organizations.

The Board of Education with the Board of Health will be responsible for the application of the tests, the notification of

[3] See the article by Dr. Dean M. Lierle, chairman of the Committee, in the present issue of the *Journal.*

the parents of the findings and of the necessary procedures to secure proper care of pupils found to have significant hearing deficiencies. Provision must be made for recording and tabulating the results of the medical and educational follow-up for reference by the school personnel and for statistical purposes.

To the Board of Education belongs the responsibility for providing the indicated educational adjustment for each hearing deficient pupil; also provision in the school health education program of definite instruction of pupils, teachers, nurses and parents concerning the safeguarding of the hearing. The Board of Education will also stimulate needed community interest among local and state medical and educational groups in the prevention of avoidable hearing handicaps.

A further duty of the State Board of Education and State Board of Health is to make provision for adequate instruction of public health and school nurses and technicians in the technic of making accurate audiometer tests. This can be done advantageously by short practical courses given by the departments of education and public health in state universities and teacher colleges with certification on satisfactory completion of the work as already offered in several states. It should be noted that the nurse, audiometer technician or teacher, however extensive her knowledge, should be admonished not to yield to the temptation to diagnose or prescribe specific medical or surgical treatment for pupils who come under her observation.

The detailed administration of a state program should be delegated by the Boards of Education and Health to a thoroughly qualified full-time or part-time Technical Supervisor of Hearing, preferably to one having had satisfactory training in public health and education. He or she should be appointed jointly by these agencies subject to the approval of the Council of the State Medical Association. He will have in charge the necessary staff and equipment to demonstrate and put into operation the program in the different school units of the state.

It should be mandatory that every pupil in a public or parochial school, unless excused on the written request of a parent or guardian, be given a hearing test by approved methods at the time of enrollment or as soon thereafter as possible, and periodically thereafter at such intervals as may be established by the Board of Health and Board of Education; also on the request of the teacher or parent and following an absence from school because of illness which might involve the hearing. Retardation and the development of speech defects call for an audiometer test.

To insure uniform accuracy of performance the audiometers used should be only those which have been "accepted" by

the Council on Physical Therapy of the American Medical Association or the United States Bureau of Standards.

Recently it has been recognized that more accurate screening tests are obtained by means of the pure tone or discrete frequency audiometer individually applied, using the sweep-check method with a fixed zero threshold, than are possible by the more rapidly applied multiple phonogaph record type with which large groups are simultaneously tested. In communities with a large school population the screening tests by the latter instruments, if already in use, will probably be continued for the duration as a matter of economic necessity. When this is done, it should be with full knowledge of their known limitations. These include the recently recognized fact that with them hearing losses for the higher pitched frequencies are not disclosed, and they are unsuitable for testing in large groups young children who are unable to write dictated numbers. Definite impairment of ability to hear sounds in the higher pitches frequently occurs in school children. This is an important advance in otology which cannot be ignored.

It is the accepted practice to check with a pure tone audiometer the findings of all screening tests made with the phonograph record group audiometer or the pure tone audiometer before referral of pupils for an otological examination. Therefore in securing new equipment the pure tone instrument is recommended, since it is useful for testing the hearing at all school age levels.

Ownership of "acceptable" audiometers by all communities having a school population of six hundred or more has obvious advantages and should be encouraged. Small schools with limited budgets and undeveloped health programs must be supplied by the state agencies with equipment on a free or loan basis and with operating personnel.

III.

The effective administration of a state plan for the conservation of hearing of school children demands special legislation:

1. Adequate public funds must be specifically appropriated to inaugurate and successfully carry out the project.

2. Responsibility for the administration of the program will be delegated jointly to the State Board of Health and the State Board of Education to make all needed regulations for its execution, the functions of each agency being closely defined.

3. Authority will be given to these bodies to enforce rigidly the provisions of the law and the rules and regulations which they involve.

4. These boards will be empowered jointly to appoint a

qualified Technical Supervisor of Hearing, subject to the approval of the Council of the State Medical Association.

The enactment of wise legislation to carry out an adequate program for the conservation of the school child's hearing can be obtained only in response to an insistent public demand based upon an awareness of the need and the important educational, economic and social benefits which will result from organized, state-wide effort in this field of preventive medicine and educational advancement.

The question of the cost of initiating and administering a practical, economical state hearing conservation program is of early concern to the taxpayer.

Conservatively administered, the cost is not excessive. The saving in the expense to the taxpayer through the avoidance of repetition of grades by hearing deficient pupils over a period of years and the reduced outlay for special education and rehabilitation of the hearing handicapped more than compensate for the cost of maintaining a program as outlined.

The law in several states makes mandatory the routine testing of the hearing of all school children each year. In the opinion of many otologists tests at such short intervals are not necessary especially in the upper grades. On this basis a material annual saving is possible in the cost of audiometer tests.

IV.

It is encouraging to note recently a definite increase in active interest in the long neglected problem of conserving the hearing.

The pessimistic, do-nothing attitude of many physicians and the laity regarding the prevention, arrest and cure of handicapping hearing impairment is changing to one of greater optimism and activity. This is the result of a better understanding of the possibilities of attainment through application of the principles of preventive medicine as related to otology. As evidence of this trend we mention the following:

Organized effort is being made by otologists, physicians, educators, public health and welfare workers to create a public awareness of the problem and a knowledge of the best methods for its solution. This has resulted in more or less successful effort to secure legislation to initiate and administer effective state programs.

Mention should be made of the outstanding pioneer work in this field by the American Society for the Hard of Hearing. With limited means it has for years led a nation-wide educational movement for better hearing and the rehabilitation of the acoustically handicapped.

The American Academy of Ophthalmology and Otolaryngology through its Committee on the Conservation of Hearing

has committed itself to a policy which includes a planned educational program to promote a better understanding of the problem. It is appointing committees of its membership in each state to carry on locally the work of the national committee. This committee under the direction of its chairman, Dr. Dean M. Lierle, has produced a new eduational 16 mm. colored sound film on the conservation of hearing entitled *The Right to Hear*. This picture which presents a dramatic story is of unusual excellence and will be of great interest to educators, physicians, nurses, parent-teacher associations, social workers and others concerned with the welfare of children.

The Academy is also preparing a *Syllabus of Procedures in the Administration of a Program for the Conservation of Hearing* which will meet an urgent need.

Today with the country at war the health of the people is recognized as our greatest national asset. Because of the war effort this is the opportune time for greater coordinated effort for the protection of the hearing of children, the civil population and those in our combat units.

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Washington this spring and put into effect in June of 1943. It provides for the establishment "in the office of the Superintendent of Public Instruction of a division of special educational aid for handicapped children, to be known as the Division for Handicapped Children. . . . 'Handicapped' children shall be classified as those children of school age, in school and out of school, who are temporarily or permanently retarded in normal educational processes by reason of defective hearing, defective sight, defective speech or by reason of other physical handicap." Efforts to establish similar programs in other states have not always been so successful, in spite of the continued work of interested persons and agencies. Thus it is the continuous responsibility of members of the American Speech Correction Association to keep informed about such programs and to support individuals and organizations working for their development.

Action implementing legislative enactments for the care of handicapped persons continues also. In Indiana a teacher licensing committee (R. Milisen, Chairman; D. W. Morris; Gordon Peterson; Mack Steer—all members of ASCA) has set up the requirements for a Speech Correction License and for

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PROGRAM FOR COMMITTEE ON THE CONSERVATION OF HEARING of the AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

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The Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology is sponsoring a program for the diagnosis and treatment of hearing defects in school children. It is their desire to formulate a practical plan which can be adopted by the various states or by local communities.

That there is need for such a program is evidenced by figures indicating that of the 50,000,000 school children in the United States, at least 60,000 are totally deaf, 3,000,00 are hard of hearing and 4,000,000 have speech defects attributable to impaired hearing. It is said that in each school room from one to three children have defective hearing. Five per cent of the school children in the United States have some degree of impaired hearing.

Some work has been done in the detection of defective hearing in school children. Except in a few instances this has been on a small scale with little done in the detection or treatment of earlier types of hearing impairment.

Incomplete surveys in Iowa indicate that not much has been done as far as remedial measures are concerned, with the exception of the excellent work being done by the Iowa State School for the Deaf.

The desire of the committee, as stated above, is to suggest a plan which may be adopted by the various states with the following purposes:

1. To establish routine testing of all school children at once, and thereafter in the third, sixth and ninth grades.

2. To bring all cases with defective hearing to the attention of the physician for treatment when indicated. Sufficient emphasis has not been placed on remedial measures to arrest the progress of deafness.

3. To provide special education for those with hearing losses which are not sufficiently severe to necessitate institutional training.

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[1] Chairman of the Committee on the Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology; head of the Department of Otolaryngology and Oral Surgery, College of Medicine and University Hospital, University of Iowa.

4. To detect all cases with hearing losses severe enough to require training in a school for the deaf, which provides vocational training, rehabilitation and eventually employment for children as they grow into adulthood.

Certain publicity should be undertaken before submitting a bill to legislatures of the various states. The problem should be presented to the various county and state medical societies, service clubs, American Legion, parent-teacher associations, school officials and the public in general.

Following this, a bill should be prepared by the legislative committee of the state medical society with the cooperation of the Department of Public Instruction and the Board of Education. The bill should contain specific information with regard to funds necessary for salaries, equipment and travel expense. Economy should be advocated. The bill, in our opinion, should appropriate funds for testing of children in public schools and, most important, provide for referral to private physicians and clinics of those cases which may benefit from treatment. Cases with more marked hearing losses should be referred to an advisory committee for recommendations concerning education and rehabilitation.

For a state with a population of 300,000 school children, the following organization is suggested:

The personnel should consist of a director; five technicians; secretary and state agent; an advisory committee consisting of the director, state agent, superintendent of the State School for the Deaf, at least two otologists, consultant in speech, director of Public Health and two lay members. The duties of this committee would be to review and make suggestions for those cases referred for educational rehabilitation.

The testing should include all children in the third, sixth and ninth grades as well as other special cases brought to the attention of the director. The tests should be given, as a minimum in these grades, at least every three years in each local school unit and more often if possible.

The method of operation might be as follows: A schedule would be formulated by the director. The superintendent of the local school unit would be advised at least a month in advance of the time of the tests. The local county medical society would appoint an otologist to conduct the physical examinations. The school officials and school nurse would assist in the examinations. At the appointed time the audiometric technician would arrive and select a suitable place for testing. Following the audiometric examination the cases with definite hearing impairment would be referred to the examining otologist. The parents would accompany the child in order to give an adequate history and to receive an explanation of the problem. Those cases which are considered remedial would be referred

to the general practitioner who in turn would refer the patient to an oto-rhino-laryngologist. Indigent cases would be referred to the various clinics. Cases with more marked hearing losses would be referred to the advisory committee who would recommend private or public schools for instruction in lip-reading, fitting of hearing aids, et cetera.

It would be the duty of the state agent or social worker to maintain a careful follow-up of all cases with impaired hearing.

No attempt has been made here to furnish specific information in regard to the necessary funds, techniques of testing, et cetera, because the relevant statements are being prepared at the present time and will be presented later.

The committee is also actively engaged in a program for the rehabilitation of service men whose hearing becomes impaired as a result of the war.

Preliminary studies reveal that there are many problems for investigation by the Committee on the Conservation of Hearing, some of which are:

1. To promote active interest in the conservation of hearing.
   - A. Special studies of specific otological diseases, such as otosclerosis, syphilis, congenital deafness, tuberculosis, acoustic neuritis, hyperplastic otitis media, and acute and chronic suppuration of the middle ear tract.
   - B. Testing of school children (formulation of state programs to promote its adoption by encouraging sound state legislation).
     1. The use of audiometric testing in the prevention, early discovery and treatment of hearing deficiencies, and in the educational adjustment of the acoustically handicapped.
   - C. Testing of adults
     1. The use of audiometric testing and of routine health examinations, in industry, in the prevention, early discovery and treatment of hearing deficiencies, and in the educational and vocational adjustment of acoustically handicapped personnel.
     2. Testing of individuals who have served in the Armed Forces with special reference to treatment, rehabilitation, et cetera.
   - D. To endorse and support the work of the Council on Physical Therapy, especially with regard to:

1. Standardization of instruments for testing hearing acuity, hearing aids and other acoustical apparatus.
2. Ethical standards of manufacturers and salesmen in the sale of hearing devices to the public.

E. Education of physicians, educators, legislators and the general public regarding the problems of the hard of hearing.

F. Encouragement of research in regard to the problems of the hard of hearing.

G. Investigation and re-organization of undergraduate and post-graduate education in otology.

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a Hearing Therapy License. The program recommended by these representatives of the Indiana Speech Correction Association has been adopted and is now in process of being put into effect. Requirements are set up which will serve to promote better training for people working with those having speech or hearing deficiencies and will assure better care for persons in Indiana who are thus handicapped. Persons not working in Indiana can well afford to study this program and to profit by the results achieved by these members of our Association.

The 1943 annual meeting of the American Academy of Ophthalmology and Otolaryngology, to be held in Chicago, will again emphasize the importance of standardized state programs for the conservation of hearing. Such programs are of direct interest to members of the speech correction profession, who are preparing themselves increasingly for the problems and opportunities for service which these programs present. By their own efforts, the deaf and hard of hearing have stimulated and continue to arouse the active interest of various professional organizations. They provide a challenging example for all other handicapped groups. The present issue of the *Journal of Speech Disorders* is a salute to them, as well as a tribute to their great friend and benefactor, the late Dr. Max A. Goldstein.

HEARING DEFICIENCIES AND SPEECH PROBLEMS

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Despite clear recognition that hearing deficiencies often bring about speech problems, the professional fields of speech correction and education of the deaf and hard of hearing have for the most part undergone independent development. The two have approached their common problem—speech deviations associated with hearing loss—in dissimilar ways. Progressive insight into this problem may be obtained (1) by discovering the factors controlling auditory discrimination for speech sounds, (2) by determining what deficiencies are associated with the various speech defects, and (3) by analyzing the speech characteristics of persons with marked hearing handicaps. The purpose of this paper is to review briefly experimental contributions on these three topics and to discuss resulting implications.

I.

Basic in the relation between speech and hearing are the factors determining auditory discrimination for speech sounds. Current thinking is strongly influenced by the well known investigations into acoustics of speech which Miller, Fletcher and others have conducted. West, Kennedy and Carr (24, 151) illustrate this view when they posit that discrimination of stops and fricatives depends upon ability to hear adequately in the frequency range from 2,400 to 8,000 cycles per second.[1] However, this view is not fully confirmed by experiments in which ability to understand electrically distorted speech has been measured. Ansberry, for example, concludes, "Persons familiar with English sounds are not handicapped in discriminating between speech sounds when frequencies above 4,000 are eliminated" (2, 389).

Need for an experimental tool specifically designed to measure ability in discrimination of speech sounds has led several investigators to develop sound recognition tests. The contributions of Fletcher and his associates (6, 255-302) are well known and need not be reviewed here. Neither need reference be made to the numerous tests designed primarily for diagnosis of hearing impairment or for fitting of hearing aids. The Travis-Rasmus test (21), on the other hand, was constructed for the purpose of measuring speech-sound discrimination. This test consists of syllable pairs. Later, Hall (8) used both the Travis-Rasmus test and one employing short phrases con-

[1] The authors point out that through context persons accustomed to hearing speech may compensate for loss in limited frequency regions.

taining one non-meaningful element. Templin (20) administered tests of the Travis-Rasmus type to elementary school children. She determined: (1) children find discrimination more difficult when consonants are in medial or final positions than when in the initial position, and (2) a short, 70-item test can be effectively used. Linton (15) undertook the problem of isolating speech-sound discrimination from other factors. After experimentation she discarded the Travis-Rasmus form for one based on a three-syllable series. Linton added to the difficulty of her test by including consonant combinations and non-English sounds. She concluded that, although her test was an improvement over previous forms, it was still too easy and too long. Furthermore, difficulty of an individual test item depended more upon the specific sound or sound combination than upon the general class of sounds to which it belonged.

As Linton stressed, existing tests do not differentiate sufficiently between the speech-sound discrimination abilities of normal hearers. This is less a criticism of the tests than it is evidence of an easily observable fact, namely, that spoken language is composed of phonetic elements with sufficient uniqueness to be easily distinguished by normal listeners.[2] Less discriminable elements do not survive the process of phonetic change which spoken language undergoes. Therefore, tests designed to measure auditory discrimination in normal hearers should not be composed exclusively of familiar speech sounds. Further work may show that the best tests for this purpose will use familiar speech sounds sparingly or not at all.

What has just been said does not apply to the use of speech-sound discrimination tests in determining the effects of hearing losses. Except where the losses are minor, instruments of the type reported above have their place as measures of broad differences in discriminatory ability. The present need is for standardization of such tests and for more exploratory experimentation with them.

In this connection Plummer (17) compared subjects' ability to discriminate fricatives, plosives and affricates with hearing acuity for pure tones. He found correlation between extent of hearing loss and total number of errors. However, difficulty in discriminating a specific sound was not related to hearing loss at a specific frequency. Although the latter result runs counter to widely held theory, it is in conformity with researches such as Ansberry's and with clinical experience. Bunch (3, 172), for example, reported the extreme case of a young doctor whose hearing dropped abruptly beyond 1,024

[2] Failure of adults to perceive unfamiliar phonemes in a foreign language is, of course, due to habituation and is not necessarily evidence of basic difference in the auditory discriminability of the phonemes involved.

cycles. Until given an audiometric test this man had no suspicion that his hearing was defective. Interestingly enough, congenital cases having similar losses show marked disturbances in language function. This obvious discrepancy emphasizes a long realized fact—that the hearing necessary to learn speech is not identical with that needed to understand it. If a person has heard speech normally while learning to interpret it, partial cues apparently suffice in the face of subsequent auditory loss. On the other hand, children whose losses appear early are likely to have defective speech habits and faulty perception for speech.

II.

Speech correctionists have attempted to discover whether hearing losses are associated with specific types of speech defects. Travis and Rasmus (21) administered their discrimination test to normal speakers and cases with functional disorders of articulation. They found that ". . . [speech] defectives made significantly more errors on the test than normals. . . " and that some relation existed between the sounds missed on the test and sounds with which the more markedly defective were having difficulty. Hall, however, reported:

> No significant differences were found between defective speakers and normal speakers in ability to discriminate between simple pairs of speech sounds, to discriminate sounds in a complex auditory pattern occurring in a meaningful context, or in auditory memory for speech sounds. . .
>
> On the 2-A Audiometer differences at every frequency were in favor of the control group but no differences were statistically significant. All composite measures on the 2-A also failed to show significance although all were in favor of the control group (8, 130).

Carrell, after administering 4-A Audiometer tests to 61 sound substitution cases and 61 controls, concluded, ". . . the sound substitution group was found to be inferior..." (4, 202). He also wrote, "Although these data are highly suggestive it can not be finally concluded from them that hearing defects have etiological significance in the consideration of speech disorders" (191). Equally indefinite were the findings of Zimmer (25). She examined pure tone audiograms for evidences of hearing loss at frequencies commonly supposed to characterize the speech sounds with which her group of articulatory cases had difficulty. In some instances decreased auditory acuity seemed related to the speech problem. On the whole, however, hearing loss did not distinguish speech defectives from normal speakers.

Gaines (7) investigated the hearing acuity of 44 cleft palate cases and 44 controls. The cleft palate cases showed somewhat greater average loss. Gaines reasoned that impaired function of the eustachian tube due to organic abnormalities associated with cleft palate is likely to affect hearing.

In a study yielding surprising results Harms and Malone (9) administered pure tone tests to 62 consecutively seen stammerers. The investigators found hearing losses ranging from 10 to 22 per cent in all cases. Positive medical histories existed in 58 cases. The authors conclude, "This group of 58 cases may be assumed to have had normal hearing originally and, therefore, a start for normal speech development. When the defective hearing interrupted these normal sounds, which in turn could cause confusion, there resulted a speech defect, namely, stammering" (660).

The picture from the above studies is inconclusive. However, it does not mean that hearing losses do not in specific cases affect speech adversely. Rather, one should reason that such cases constitute a small enough proportion so that in general samplings of the speech defective population their identity may be obscured by methods of treating the data. Furthermore, relations which exist can emerge only to the degree that experimental analyses are based upon correct assumptions as to the acoustic characteristics contributing to speech-sound discrimination.

III.

A very different approach deals with the speech of persons having marked hearing losses. Studies following this plan have utilized pupils in schools for the deaf. Although such pupils usually have pronounced speech deviations of types seldom encountered in speech correction practice, these studies throw interesting light on relations between speech and hearing.

Hudgins (10) compared the speech co-ordinations of deaf and normal hearing subjects. Using kymographic apparatus, he discovered the speech of the deaf to be slow and labored, to evidence high chest pressure, to be characterized by excessive expenditure of air, to contain prolonged vowels with accompanying distortion, to have rhythm abnormalities, and to be excessively nasal. He found positive correlation between speech abnormality and extent of hearing loss.

Rawlings (18) conducted a similar study. Certain of his findings agree with those of Hudgins. Beyond these Rawlings reported that the deaf show ". . . improper function of consonants with consequent addition of extra syllables between abutting consonants. . . " and ". . . the deaf expend relatively little more breath in speech than do normal subjects over a given period of time" (18 [1936], 149).

In another study Hudgins (11) noted that breathiness is an important characteristic of most deaf voices. He also found that quality may be good on isolated sounds but bad in connected speech.

Voelker (23) observed that deaf children were capable of pitch changes approximating in rapidity and extent those of normal hearers. However, "The deaf showed little more than half as great an average maximum pitch variation as did the normals for the same sentence" (259). Atypical intonation patterns and slow rate were also evident.

In a second study Voelker (22) found that only about 15 per cent of the deaf children spoke 90 or more words per minute. Mason and Bright (16) found that the speech rate of the deaf was abnormally slow, that the rate did not vary with thought, that the rate on a given sentence was more variable for deaf than for hearing subjects, and that in most cases the slowest hearing subject took less time than the fastest deaf subject.

Kerridge (14), on the basis of wide experience in London, reported defective speech in 33.5 per cent of children who were "partially deaf." Interestingly, [s] and [ʃ] were most often defective. Furthermore, 60 per cent of the children with defective speech had greatest losses for high frequencies, 39 per cent had their major loss in the middle range, and 1 per cent showed uniform loss. Kerridge also presented graphical summaries of her findings on the relation between hearing losses and defective speech. Ewing (5) analyzed ten cases of "congenital aphasia." In six instances he found marked hearing losses above 256 cycles per second. He attributed the "aphasic" reactions in these six cases to disturbances in perception of speech due to the type of hearing loss. Shaw (19) attempted to find correlations between articulatory errors of ten hard of hearing cases and their pattern of hearing loss. Speech correction and auricular training yielded noticeable improvement in the speech of eight out of ten subjects.

Heider and Heider (1, 23-41) found that deaf children gave symbolic values to phonetic combinations. Kinaesthetic factors played a major role. Because of these factors some shifts in the speech of the deaf may be toward patterns which are subjectively more satisfying rather than shifts due to forgetting.

Sykes (1, 104-123) found the spontaneous vocalizations of young deaf children to contain practically all the English speech sounds. She reported the frequency with which different sounds and sound combinations appeared.

Hughson, Ciocco, Witting and Lawrence (13) compared articulatory abilities of children trained by auricular and oral methods. The authors state, "Under all conditions of residual auditory acuity, the speech of children trained by the auricular method is superior. . . Residual auditory acuity in children trained by the oral method apparently has no bearing on speech response" (890). Both age of onset and age at the time of the

investigation were related to speech excellence. However, "In children trained by the auricular method there is continuous improvement in speech characteristics with duration of training. No comparable improvement is observed for children trained by the oral method" (890).

Hudgins and Numbers (12) analyzed speech samplings from 192 deaf pupils. The following findings are of particular interest:

> . . . approximately 21 per cent of all consonants and 12 per cent of all vowels were malarticulated. . .
>
> Errors involving the surd-sonant distinction, compound consonants and the failure of the releasing consonants were found to be the most frequent of the error categories, and also the most important relative to speech intelligibility. . .
>
> Vowel substitutions and malarticulation of diphthongs were the most important of the vowel error types by the above criteria. . .
>
> The frequency of errors of articulation and errors of rhythm inceased with increased hearing loss. . .
>
> . . . sentences spoken rhythmically correct have almost a 4 to 1 chance of being understood over those spoken with incorrect rhythm. . .
>
> . . . the contributions of rhythm are just as great as those of consonants and . . . both . . . are of greater importance than vowels in determining speech intelligibility (387-389).

On the basis of their experiment, Hudgins and Numbers ranked the difficulty of speech sounds for deaf speakers. The order of difficulty did not agree with the judgments as to difficulty of twenty teachers of the deaf. In closing the authors say:

> The findings of this study suggest the need for a reconsideration of current methods of speech teaching in schools for the deaf. Hard-of-hearing pupils . . . should be taught by visual-auditory methods. . . Profoundly deaf pupils, to whom speech must remain a series of movements, must be given every opportunity to develop the complex movement coordinations which make up the speech process (339-390).

As the foregoing summaries indicate, the speech of deaf and markedly hard of hearing children is abnormal in many respects. Obviously, auditory inadequacies make it difficult for these children to learn speech, but we must remember that the characteristic defects which have been observed are due in some measure to current teaching methods. In other words, studies on this problem have done little more than begin to abstract the basic etiological relationships between pronounced hearing deficiencies and speech abnormalities.

IV.

The outstanding conclusion to be drawn from investigations here reported is that phenomena of hearing for speech and the consequent influence of hearing loss upon speech normalcy are poorly understood. Among profitable topics for future research are the following: (1) nature of normal auditory discrimination for isolated speech sounds and for connected speech; (2) effects of degrees and types of hearing loss upon

auditory discrimination; (3) influence of impaired audition upon learning of normal speech habits; (4) influence of impaired audition upon retention of normal speech habits; (5) pedagogical methods best suited to teach speech to hard of hearing and deaf children; and (6) techniques most effective in correcting faulty speech growing out of acquired auditory deficiency.

Until our knowledge of these topics is amplified, we must proceed on the basis of information at hand. In doing so it is wise to keep a few points in mind. First, we must continually distinguish persons whose hearing impairments appear following the acquisition of speech from children whose losses are congenital or appear early enough to interfere with learning speech. Each group presents its special problems. Second, there is little evidence that in the former group normal acuity for high frequencies is as essential as is often supposed. Finally, more sharing between speech correctionists and teachers of the hearing handicapped will accelerate research toward solving questions common to both fields—questions of the inter-relations between audition and speech.

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A SELECTED BIBLIOGRAPHY ON HEARING AND DEAFNESS

Prepared for the Committee on Rehabilitation by

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In the March, 1943, issue of this *Journal* it was announced that the Committee on Rehabilitation of the American Speech Correction Association ". . . has assumed responsibility for preparing annotated bibliographies covering areas of special interest in wartime speech rehabilitation. Each bibliography is to be short. It will be designed to give a basic survey—in terms of the special needs for speech correction—of the areas covered."[1]

The following is a bibliography in this series. It consists of key items surveying hearing tests, the evaluation of hearing losses, hearing aids, and war damages to hearing.[2] Since the

[1] Report of the Committee on Emergency Defense, *Journal of Speech Disorders*, 1943, **8**, 38.

[2] Professor Bessie L. Whitaker has prepared a separate bibliography on lip reading which appears elsewhere in this issue.

bibliographical items are arranged in a progressive sequence, it is suggested that they be consulted in the order listed.

This bibliography presupposes the general knowledge of acoustics and of hearing which is standard background in speech correction. Sources covering this background are omitted. Special attention, however, might be called to a classic survey of the psychology and physiology of audition, namely: Stevens, S.S. and Davis, H. *Hearing.* New York: John Wiley and Sons, 1938.

Hearing Tests

Gardner, W. H. *Instructions for Conducting Audiometer Tests.* Washington, D. C.: American Society for the Hard of Hearing, 1940.
This manual gives specific and authoritative directions for administering and scoring phonograph audiometer tests, and for administering and interpreting pure tone audiometer tests.

Fowler, E. P. Tests for hearing, *Nelson Loose-Leaf Medicine of the Ear.* (Edited by E. P. Fowler). New York: Thomas Nelson and Sons, 1939. Pp. 369-423.
This chapter in the *Nelson Loose-Leaf Medicine of the Ear* presents a thorough discussion of tuning fork, voice, and pure tone audiometer tests. Precautions for accurate test administration are described.

Lewy, A. and Leshin, N. Functional examinations of hearing, *Arch. Otolaryngology,* 1942, 35, 437-479.
This is a detailed survey of much pertinent literature of recent years covering not only hearing tests but also hearing aids, conservation of hearing, and war damage to hearing.

Significance of Hearing Loss

Beasley, W. C. Characteristics and distribution of impaired hearing in the population of the United States, *J. Acoustical Soc. Amer.,* 1940, 12, 114-121.
Beasley analyzed data gathered during the National Health Survey of the United States Public Health Service and, on the basis of this analysis, presents hearing norms.

Bunch, C. C. Usable hearing, *Annals of Otology, Rhinology and Laryngology,* 1940, 49, 359-367.
On the basis of selected audiograms Bunch computed the maximum hearing loss permitting speech perception.

Hughson, W. and Thompson, E. Correlation of hearing acuity for speech with discrete frequency audiograms, method of determination, *Arch. Otolaryngology,* 1942, 36, 526-540.
The authors present a careful technique for comparing threshold loss in hearing with impairment in perception of speech.

Carter, H. A. Review of methods used for estimating percentage loss of hearing, *Laryngoscope,* 1942, 52, 879-890.
Eleven methods of estimating percentage hearing loss are described, and essential considerations for a medicolegal standard for computing percentage hearing loss are presented.

Anon. (Council on Physical Therapy of the American Medical Association.) Tentative standard procedures for evaluating percentage of useful hearing loss in medicolegal cases, *Arch. Otolaryngology,* 1942, 36, 590-592.
Several specialists contributed in the construction of a standard chart which may be used for computing the percentage of hearing loss and which was adopted by the House of Delegates of the American Medical Association in 1942.

Hearing Aids

Kranz, F. *Hearing Aids.* Elmsford, New York: Sonotone Corporation, 1941.
Kranz describes in simple terms the parts which compose the modern hearing aid, explains the function of each part, and discusses the application of hearing aids to various types of auditory impairment.

Bunch, C. C. Hearing aids, *Trans. Amer. Academy of Ophthalmology and Otolaryngology,* 1942, **46**, 163-178.
In a concise but comprehensive article Bunch covers both theoretical and practical considerations in the selection of hearing aids.

Information please: Regarding hearing aids and audiometers, *Trans. Amer. Otological Society,* 1940, **30**, 155-191.
This is the report of a panel discussion in which eight authorities contributed valuable facts and opinions regarding hearing aids and audiometers.

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Macfarlan gives a comprehensive list of the hearing aids accepted by the Council on Physical Therapy.

Senturia, B. H., Silverman, S. R. and Harrison, C. E. A hearing aid clinic, *Annals of Otology, Rhinology and Laryngology,* 1943, **52**, 131-145. Reprinted in *J. Speech Disorders,* present issue (Sept., 1943).
Here is a report on apparatus and procedures used in assisting the hard of hearing person to select a suitable hearing aid.

Berry, G. The case for the hearing aid, *Laryngoscope,* 1942, **52**, 615-628.
Berry gives a comparative evaluation of the fenestration operation and of the hearing aid.

War Damages to Hearing

Bunch, C. C. Traumatic deafness, *Nelson Loose-Leaf Medicine of the Ear.* (Edited by E. P. Fowler). New York: Thomas Nelson and Sons, 1939. Pp. 349-367.
Bunch presents a comprehensive discussion of the character of traumatic deafness and of the causes which induce it.

Bunch, C. C. The problem of deafness in aviators, *War Medicine,* 1941, **1**, 873-886.
Bunch here analyzes the damaging effect of airplane noise upon hearing.

Macfarlan, D. Prevention and treatment of acoustic trauma in war and in civil life, *Trans Amer. Otological Society,* 1941, **31**, 272-277.

Lewis, E. R. Malingering and neuro-otologic considerations in combat services, *Trans. Amer. Otological Society,* 1941, **31**, 278-281.

Pappen, J. R. The ear in flying, *Trans. Amer. Otological Society,* 1941, **31**, 282-291.
The above three references are pertinent contributions from a symposium on military otology conducted as part of the 1941 meeting of the American Otological Society. Other contributions to the symposium and the discussions which concluded it are also of interest.

Ophthalmology and Otolaryngology, (National Research Council Military Surgical Manual, No. II). Philadelphia: W. B. Saunders Company, 1942, 161-303.
This is one of a series of official manuals for special branches of war medicine prepared under the auspices of the National Research Council. The topics are treated from the medical point of view, but their scope gives the layman a valuable and embracing picture of war damages to hearing.

LIP READING—A CONTINUING NECESSITY

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I.

Last week I was walking down Twenty-Third Street in New York, away over on the West Side, near London Terrace. A little girl about four years old came up to me and said shyly, "Will you please walk across the street with me?"

"I shall be happy to walk across the street with you," I replied. "Where do you want to go?"

"I live over there." She gestured. "My mother won't let me cross by myself."

I took her hand and guided her through the traffic. When we reached the other curb, she dropped my hand and darted across the sidewalk and into a doorway, waving to me as she ran. I glanced up toward the building, and at an upper window a pleasant-faced woman holding a baby in her arms nodded and said, "Thank you," through the glass. I went on about my business with a little glow at my heart.

Somewhat later the same day, I went into the B. & O. Railway office on 42nd Street to inquire about trains to West Trenton, New Jersey. I had to reach West Trenton by nine o'clock in the morning.

"There is no uptown connection that early," said the clerk. "You will have to take the Fulton Street Ferry to Jersey City at seven, and from there take the Jersey Central. That will get you into West Trenton at eight-forty-five."

"How do I get to the Fulton Street Ferry?"

"Take the Seventh Avenue Subway at Times Square and get off at Cortlandt Street."

"Get off where?"

"Cortlandt Street."

"Does the express stop there?"

"No. You'll have to change to the local at Fourteenth Street."

Two very commonplace episodes, but both important to the smooth flow of daily life. The point of them as related here is that I am totally deaf, and in both of these transactions I understood by means of lip reading what the other person said. The ticket seller would have been perfectly willing to write if I had not understood him, for all ticket sellers have to deal with deaf persons; but the little girl was not old enough to write, and if I had not read her lips I would have bewildered and frightened her, and would myself have missed a charming contact.

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II.

There are plenty of people who go about their business day by day, talking and being talked to, carrying on the ordinary verbal contacts with the world, not hearing one word that is said. There are much larger numbers of other persons who hear part of what is said, but not enough to get the meaning clearly without the complementary aid of lip reading, or speech reading, as some prefer to call it.

"Speech reading," says Miss Anne Bunger, "is understanding spoken language while watching a speaker, without fully hearing, or if need be, without hearing at all" (1).

That is the best definition of lip reading that I have seen. It takes into consideration the factors that make for successful lip reading (and if it isn't successful it isn't lip reading) and it tells exactly what a lip reader does. He watches the speaker. He does not necessarily concentrate on the lips alone; he watches the whole face, the whole body of the person who speaks. Facial expression, gesture, movement, may all aid or hinder lip reading. For instance, I find it much more difficult to understand a blind person than one who sees, since I depend a great deal on the expression in a speaker's eyes; and I understand persons with alive, mobile facial expression much better than those who were born with, or have cultivated, poker faces.

Another reason I like Miss Bunger's definition is that she does not call lip reading an "art." It is an art, truly, but calling it that sets it outside the run of utilitarian necessities of life, where it definitely should be classed. It is a necessity for every hard of hearing person, no matter how slightly hard of hearing he may be. To quote Dr. Max Goldstein:

> To the partial or incurably deaf the acquisition of lip reading is a manifold blessing; it releases him from the constant handicap of his aural infirmity; it relieves the constant nervous strain and embarrassment of isolation from the rest of his fellows; it restores his social status and his means of communication with his fellow men. To the otologist it offers a consolation for his inability and impotency to cope with certain forms of aural pathology and it places him in a position to restore the peace of mind and to instil new hope in his deaf patient (2).

Also, once learned, lip reading will stay by the hard of hearing person through life. The best hearing aid in the world breaks down at times; many cases of deafness are progressive, and there may come a day when no hearing aid will serve. Happy is that hard of hearing individual who has, from the onset of deafness, cultivated and assiduously practiced the habit of watching those who talk to him and interpreting what he sees in terms of speech.

So much for the hard of hearing adult, who possessed normal hearing and normal speech during his years of growth. For the deaf child, who lost all or most of his hearing before

he learned to talk, lip reading is one of the most important educational requisites. It comes before speech, and it goes with speech as a means of communication all through his life. Deaf children, as young as two or two and a half, who, because of their lack of hearing, have not learned to say one word, may be taught to understand, by means of lip reading, many nouns and simple commands, as well as whole sentences: "Come to mother. Where is daddy? Show me your shoe. Show me your thumb. Shut the door. Bow. Wave your hand. Clap your hands. Fold your arms. Hello! Walk. Run. Show me the baby. Show me the bow-wow. Show me the auto. Will you have some potato? Please give me the bread. Please bring me a glass of water."

There is an almost incalculable difference between the deaf child who has thus been put in touch with his world and the child who is allowed to grow up to the age of six or seven with no knowledge of language. The severely deaf child is without language and without speech. He does not know that anything has a name; he does not know that the movements of the mouth have meaning. His acquisition of speech is a long, slow process, involving technical training on the part of a teacher; but lip reading facility can be developed by his mother if she will take the trouble, and with her aid he can acquire a considerable lip reading vocabulary before he goes to school. If lip reading is begun early enough it becomes a part of the deaf child's make-up and greatly facilitates his language learning, besides being a powerful incentive in the difficult process of learning to speak.

III.

Lip reading, then, is a prime necessity for every person with any degree of hearing loss. How is it to be acquired? Until about fifty years ago, the only persons who attempted to teach it were instructors of deaf children, and they had not worked out any definite formula for teaching it. They used it to start the deaf child's vocabulary, but they expected facility in lip reading to grow automatically along with the vocabulary. They made little effort to find out why lip reading was easy for some children and very difficult for others; and they did not analyze the lip reading mistakes the children made, with a view to helping them avoid such errors.

For a long time, in fact, teachers of the deaf did not really believe in lip reading. Bonet (3), who published in 1620 the earliest work on the teaching of speech to the deaf that has come down to us, did not believe that lip reading could be *taught*, though he acknowledged its possibilities. When Alexander Graham Bell began to teach the deaf, he did not attempt to use lip reading. His first pupil was the small son of a Salem, Massachusetts, business man; and Mr. Bell taught the five-

year-old child speech and language in return for time and space in which to perform the experiments which led to the invention of the telephone. He was an expert teacher of speech, of the third generation of a family of speech experts, and he had early discovered that even a totally, congenitally deaf child could be taught to speak understandably. However, knowing how few of the movements of speech are outwardly visible, he did not at first speak to his little pupil, but taught the boy language by means of a lettered glove which he copied from one described in a book written by George Dalgarno (4) in 1680. The little boy wore the glove on his left hand, and Mr. Bell spelled to him by touching the letters. The two of them acquired such dexterity that Mr. Bell could touch several letters at once, as one plays chords on the piano; and the child at six had a language facility most unusual in a deaf child of that age.

Just about this time, Mr. Bell began to pay frequent visits to the Horace Mann School for the Deaf, a day school located in Boston, and he found that he could talk rapidly and easily with many of the pupils in the ordinary manner of speech, and, so long as he used language with which they were familiar, they understood everything he said. With characteristic open-mindedness, he threw his former theories overboard, and concentrated on the possibility and the value of lip reading for the deaf (5). As he remarked in one of his essays, "The children really did seem to understand, to a very useful extent, the utterance of their friends and their teachers; they were not deaf at home; they were not deaf with their teachers; my curiosity was so much aroused to ascertain the cause of what seemed from my point of view impossible as to lead me to make the instruction of the deaf my life work."

He went into the subject with his usual impetuosity, studying it to such advantage that, a few years later, he made lip reading the subject of an essay which he read before the Philosophical Society of Washington, D. C. In this discourse he remarked that he had "made an examination of the visibility of all the words in our language contained in a pocket dictionary, and the result has assured me that there are glorious possibilities in the way of teaching speech reading to the deaf, if teachers will give special attention to the subject" (6).

A few teachers of the deaf did give the subject attention, but the first individuals who worked out special methods of teaching it were hard of hearing adults, who began to teach other hard of hearing adults to read lips. With the turn of the century came a spurt of interest in lip reading, and schools sprang up throughout the country in which lip reading was taught and studied and practiced by persons in adult life who

had lost or were losing so much hearing as to make communication difficult.

For some years, such schools as were opened in the United States all stemmed from two parent schools: that established by Martha E. Bruhn in Boston in 1902, and the one opened in New York the same year by Edward B. Nitchie. In 1917 Miss Cora Elsie Kinzie of Philadelphia announced that she had formulated a new method of instruction in lip reading, and she also began to train teachers who went out and opened schools of their own. Until the late twenties these lip reading schools continued to grow and spread, and many of them were prosperous.

Lip reading classes for adults were established in night schools in the larger cities, most of them under the guidance of teachers trained in the three schools mentioned above. Organizations of the hard of hearing, growing out of the lip reading classes, made the acquisition of lip reading one of the chief motivations of their "get-togethers." With the invention of the audiometer, and the discovery of large numbers of hard of hearing children in the public schools, classes of lip reading for children were established, and became part of the educational program in many large cities. Several universities included lip reading in their schedules and training courses for teachers of lip reading were incorporated in their curricula.

Then two things happened that halted this steady growth of lip reading. The depression caused the lopping off of many educational enterprises; and the great improvement in hearing aids caused many hard of hearing adults to conclude that lip reading was not so necessary as they had been led to believe. By paying out a hundred dollars or so, they could attach to their persons an instrument that enabled them to hear "almost everything" right away. Lip reading, on the other hand, involved a long and arduous course of lessons, or maybe several courses, at sixty dollars each, and even this application and outlay did not bring them to the point where they could understand "everything."

Attendance at private schools of lip reading began to drop off; public school classes grew smaller or were discontinued altogether; fewer teachers took up lip reading as a life work; and those who did were content to follow along the lines already laid down, so there were no adventurous spirits to hew out new paths and give lip reading new impetus.

Nobody is more willing to admit the limitations of lip reading than the person who is utterly dependent on it. It has been called a crutch, and such it is; but it enables many individuals who would otherwise be at a standstill conversationally to get about quite well and quite surely. So long as there is deafness, lip reading will be important; and it behooves us to

take it seriously. Since, both as an art and as an educational tool, it is now rather at a crossroads, we might stop and try to sum up what lip reading has accomplished and what it still has to achieve.

IV.

First, it is in order to examine the various methods by which lip reading is now taught. When Miss Martha E. Bruhn, a teacher of modern languages in Boston, found that her growing deafness was interfering with her work, she departed for Germany, where Herr Julius Müller-Walle, a teacher of deaf children, had evolved a method of teaching lip reading to hard of hearing adults. She studied with him, became an expert lip reader, and, with his encouragement, began to translate his method into English. This meant a good deal more than merely translating a book from one language to another. A lip reading exercise which presents the visible movements of speech in German may not have at all the same effect when transcribed in English. Miss Bruhn had to work consonant by consonant, and vowel by vowel, to find equivalent English words to illustrate the lip reading principles expounded by Herr Müller-Walle.

The method is founded on sound educational principles, for it works from the known to the unknown, from the simple to the complex, from the easy-to-see to the practically invisible. Taking the broad *ä*, the vowel that, from the lip reader's viewpoint, is easiest to understand (just as it is the easiest of the vowels to hear) Miss Bruhn combined it with the consonants that are most clearly visible—*f* and *m*—and made the word *farm*. *Sh*, too, is clearly visible, so the lessons began, *Show me the farm. Show me the ship. Show me the shop.* Almost anybody can read those sentences from the lips at first try, and understand them so readily that the teacher is able to speak smoothly and rapidly, in a conversational manner. And that is the beginning of lip reading.

The first lessons are almost wholly objective. The drills for eye training involve practice on meaningless syllables, which are carefully arranged and graduated, so as to accustom the pupil to recognize the visible movements of speech. As he progresses, he is given more interesting and meaningful material, and the psychological aspects of lip reading are emphasized; but the syllable practice, the eye drill, is continued throughout the course (7).

That this drill has its drawbacks may be exemplified by the complaint uttered by a deaf man who had come to a teacher of lip reading for practice in both lip reading and speech. Although possessed of considerable hearing, he had been educated by means of the sign language, and could neither read the lips nor recognize speech sounds by ear. Wearing a hearing

aid and watching the teacher, he was laboriously building up a spoken vocabulary, but his progress was so slow that it took three or four lessons to cover material most adults accomplish in one session. Even after he had begun to make some progress, he was dissatisfied, and one day he shoved the papers and the lesson book away from him and wrote rapidly, "Why must I talk about the ship and the farm? I am a cleaner and presser."

He put his finger on one of the chief requisites in lip reading instruction: It is not enough for the practice material to offer carefully assorted lip movements; it must also offer thought content that is of interest to the pupil. This business of combining the necessary drill with spontaneous interest in subject matter is difficult to manage in teaching either children or adults.

Mr. Edward B. Nitchie, who opened a school and formulated a method of lip reading instruction the same year that Miss Bruhn opened her school in Boston, gave his attention to the psychological aspects of lip reading. His first published textbooks included laborious analysis of speech movements, but he quickly got away from that, and, recognizing the fact that only about half the movements of speech are visible, he emphasized the necessity for training the student to grasp whole meanings from the segments of speech that are seen (8). The school he founded was the nucleus of the New York League for the Hard of Hearing, and many of the teachers he trained went out into the country to found other schools and other leagues. Recognizing the debilitating effect that deafness has on the personality, Mr. Nitchie believed firmly in the regenerative possibilities of lip reading, and his belief laid the foundation for the widespread social service work that is now being done for the hard of hearing everywhere (9, 10).

Miss Cora Elsie Kinzie studied under both Miss Bruhn and Mr. Nitchie, and when she began to build her own system of teaching, she took over the first three lessons of the Müller-Walle Method, believing that the selection of vowels and consonants which they incorporate could not be improved upon for starting a pupil in lip reading. She found, however, that some pupils could go faster than others, and that if the practice material were graded it facilitated progress. She also found that methods of presentation used by the teacher could measurably aid or hinder a pupil, and so she evolved a system of teacher training which provided for clearly defined and carefully proved rules of procedure in giving a lesson (11).

All three of these methods are different from one another; all are similar, however, in that they include the analysis of visible speech movements and the practice of these movements in words and sentences; all recognize that the mind must be trained to grasp the meaning of speech movements that

cannot be seen. In other words, all these methods assume that the eye affords the only sensory channel available to the lip reader, and that the eye must be supplemented by the "trained guess work" achieved through inference and general interpretation.

The Jena method of speech reading instruction, founded in Germany, introduced in America in 1926 at Michigan State Normal College, and now being taught in several centers in different parts of the country, represents a radical departure from the three methods briefly described above. The Jena method calls attention to the muscle sense, the kinaesthetic sense, the "feel of movement," and utilizes it. The pupil begins from the start to recite *with* the teacher, on the theory that when a man makes the same speech movements as a speaker, speaks with him, he will have the same speech sensations, will feel the words as the speaker feels them, and will understand through feeling. The system of practice enables the hard of hearing person to become aware of his own speech sensations and through them understand the speech of others.

> The pupil memorizes series of meaningless syllables, and then, facing the teacher and watching her, he tries to speak the series at the same time that she speaks them. His gaze includes gesture, mien, and facial expression, but he does not try to see individual movements of the mouth. He merely looks at it effortlessly. Yet at the end of a week or two of drill, he can say with the teacher many series of syllables. Soon he can do this not only with syllables in pre-arranged, memorized order, but with those in random order. During this time, his attention has been directed from seeing to feeling, and as every possible sound and sound combination is introduced, he has come to know the feel of each.
>
> The syllables are spoken rhythmically, in musical tempo, and this is accompanied by movements of the body, arms, legs, hands, head, marching and dancing . . . After a time, meaningful phrases or series of words may be interpolated into the syllable drill, counting days of the week, months, dates, money, weights . . . It is found that the student can say these also with the teacher, and can understand them. The third part of the practice course is devoted to spontaneous speech—talks, lectures, dialogues . . . There is never any reading (12).

Still a fifth method of teaching lip reading was evolved in the Speech Clinic at Ohio State University, where Dr. Marie Mason superintended the making of lip reading films based on exercises designed to demonstrate the various movements of speech. The student, having mastered the theory of lip reading, goes into a dark room in the laboratory, throws a silent motion picture on a screen, and studies it at his ease, running the film over and over until he has learned the particular lesson involved. The advantage of this method is that the shy or timid student can study by himself, and the slow student can repeat any difficult lesson until he has had time to master it. The disadvantage is that the film cannot take the

place of an interested, enthusiastic teacher, eager to help the pupil and encourage him (13).[2]

The Psychological Clinic at the University of Southern California took up lip reading about five years ago, and in 1941 put on the market a series of silent films, dramatized "life situation" motion pictures, arranged to make the study of lip reading more interesting and its acquisition more rapid. While the founders of this system, Dr. B. V. Morkovin, Mrs. Lucelia Moore and Miss Ruth Bartlett, state that they do not claim to have invented a new method, yet the system is commonly characterized as a method.

As a matter of fact, it embraces a little of all the other methods. Motion pictures are used, but there is plenty of speech practice with a teacher, also. There is syllable practice for eye drill, and there is rhythmic repetition of speech sounds with the teacher. A somewhat radical departure is that the teacher uses a normal tone of voice throughout the practice period, instead of lowering her voice to compel the pupil to read her lips. If pupil or teacher is accustomed to wearing a hearing aid, he keeps it on during the lip reading lesson, and hearing and lip reading are combined throughout. The name of this method—"audio-visual-kinaesthetic"—implies that it includes all three approaches (14).

There are objections to the use of hearing during the lip reading lesson, since it is assumed that one cannot concentrate on the visual if one is listening at the same time; and lip reading practice is not lip reading practice if the pupil hears more than half of what is said. The advocates of this system, however, say that it reproduces the conditions faced by the average hard of hearing person in normal conversation, and so affords the best means of practice. Also, it is said, the use of the dramatized motion picture makes lip reading practice more vivid and more closely allied to life situations. The objections to the pictures are based on their imperfections both as motion pictures and as exemplifications of selected speech movements. Unless the actors are good actors, unless they speak distinctly and face the audience, unless the dialogue is not only carefully written from the lip reading standpoint, but is also synchronized with the action and gesture shown in the picture, the lip reading student just wastes time looking at pictured talk, not one word of which he can understand.

V.

This brief outline of six methods of lip reading instruction, all now in vogue, and each advocated by its adherents as the "best," may present a confusing picture of lip reading. This

[2] See also Dr. Mason's article in this issue of the *Journal of Speech Disorders.*

is further complicated by the fact that the improvement in hearing aids has taken much of the attention of the hard of hearing away from lip reading, with the result that there has not been a sufficient spur to new inventions and new techniques.

That there is room for new techniques is obvious, for there are pupils in schools for the deaf who never learn to read lips with any degree of facility, and there are hard of hearing adults who attend lip reading classes faithfully for years without learning enough lip reading to depend on conversationally. Some teachers of both the deaf and the hard of hearing have accepted this condition as inevitable, remarking that it is caused by the mental make-up of the individual. Some persons have "lip readers' minds;" others don't. Some are able to make the quick transition between seeing and the mental "filling in" that supplies meaning; some are too analytical to do this quickly; some never learn to do it **(15)**.

All teachers of lip reading recognize this condition. Miss Bruhn has made a careful study of the psychology of language, and has applied it to the construction of improved practice material. At the Nitchie School in New York, Thorndike's *Word Book* is used to select words most commonly employed in everyday speech, and practice is built around these. In a recent widespread project in New York City to train teachers to give lip reading instruction to hard of hearing children, charts were constructed in the effort to determine "with mathematical accuracy" the visibility of each sentence used in the lip reading practice material **(16)**. A visibility chart was constructed, showing a constant numerical value for each sound of English. "Paying meticulous attention to the formation and revelation of each sound, we arrived at the following chart of 'Visibility Values for the Sounds of English' . . . As herein presented the chart may be used by any lip reading teacher to compute the visibility percentage of any given sentence." The hope is added that no teacher will fall into the error of over-emphasizing visibility in the construction of his sentences to the point where naturalness is sacrificed.

In the research department at the Clarke School for the Deaf, Northampton, Mass., extended experiments in the psychology of lip reading have been carried on, to determine the type of mind that guarantees good lip reading and the type of mind that seems to be unable to master lip reading. Some interesting findings have resulted. For instance, it was learned that good lip readers are apparently more responsive to color than to form, whereas poor lip readers are more responsive to form **(17)**.

There should be more research along this line, and more use should be made of the research that has already been

done. Lip reading should not be allowed just to happen or not to happen. Ways should be studied to make better lip readers out of the poor ones. Experiments should be performed to find out whether the use of hearing simultaneously with lip reading stimulates or interferes with the development of lip reading ability. Careful studies already made in schools for the deaf would seem to indicate that the more hearing a child has and the more this hearing has been trained, the better his lip reading will be (18). Such experiments have not been tried with the adult hard of hearing, and the argument is still wide open.

There is a manifest cleavage between methods of teaching lip reading to adults and those used with deaf children; and this results not only from the language requirements of deaf children as compared with the normal language of adults, but also from the fact that teachers of lip reading to adults are nearly all lip readers themselves, practicing assiduously the art they endeavor to impart, and vitally interested in its improvement; while teachers of the deaf often make a point of *not* reading the lips, on the theory that if they do they may accept poor speech from their pupils instead of correcting it. It is a fact that deaf children, who have been taught to articulate correctly, often make the required lip movements for speech without giving the proper sounds, and so are easier to understand through lip reading; but the teachers' determination not to know how to read lips works more harm than good, for they do not know what is difficult to see and what is easy to see, and they do not recognize the many difficulties involved in lip reading, nor the extraordinary achievement it represents, once it is mastered. If I had my way, I would make every teacher of the deaf "sit under" a good teacher of lip reading and learn about lip reading the hard way, by having to do it.

At present, the whole business of imparting lip reading is, as mentioned above, at a crossroads. The older methods are forty years old; the newer methods are not very radical departures, but are more or less a composite of the old. Can anything new be learned? Can a more exact psychological analysis facilitate the development of more exact methods of teaching? Can there be a better balance between eye training and "mind" training? Can muscle training be added to these, to aid the balance? What is a lip reader's "mind"? What makes a good lip reader and what makes a poor one? Why is the development of the tactile sense in a small child such a help to improved lip reading? Could this sense be used with adults? All these questions need to be answered, both in the laboratory and in the classroom. For lip reading is a vital necessity; nothing but the elimination of deafness will ever cast it into the limbo of lost arts. It will be practiced so long

as deafness has to be reckoned with; it could be practiced to much greater advantage if more people would learn more about it (19).

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A CINEMATOGRAPHIC TECHNIQUE FOR TESTING VISUAL SPEECH COMPREHENSION[1]

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I. INTRODUCTION

We live in a world of sound. Our daily experiences are filled with the mechanical sounds of industry, the elemental sounds of nature, the cries of animals, and the voices of human beings. The vibrations which make up this sound world reach us through the ear, the tactual senses, and the eye.

The individual with a reduced or negligible hearing acuity lives in this same world of sound. Depending upon the extent of his auditory deficiency, he hears these various sounds either not at all, or with diminished intensity. Inability to hear the speech of those with whom he comes in daily contact may be compensated for, either wholly or in part, by the power to understand what is said by means of vision. Since for him the eye functions instead of the ear, this visual comprehension of spoken thought is referred to as "visual hearing" throughout this study. It takes the place of "lip reading," the commonly accepted expression for this medium of communication, and of "speech reading," a term of more recent usage.

The degree to which spoken thought may be comprehended visually has been ascertained previously for the most part from a teacher's subjective impression of a pupil's ability on a teacher-made and teacher-scored test of such attainment. While the need of objective criteria for measuring a student's visual-hearing ability has been realized by educators, but little scientific investigation of this question has been made. Two of the first to be published were those of Kitson (7, 1915) and Conklin (1, 1917).

Comprehensive research endorsed by the National Research Council was conducted during 1924-25 by Day, Fusfeld, and Pintner (2). Two lip-reading tests (ten sentences each) comprising the entire range of speech sounds were constructed and administered to 8300 pupils. Pintner (10, 1929) in commenting on these tests says, "These speech-reading tests prepared by Day and Fusfeld are the first attempt at objective measurement of these abilities among the deaf," and later (11, 1941), "It can readily be seen that these tests of speech and lip-reading are far from objective and cannot be considered standardized tests; nevertheless, they are the best that have been used up to the present time."

Göpfert (5) experimented with lists of vowels, consonants, words, and sentences, testing many children and adults. Goldmann's (4) research, in which he used words and sentences, led to his conclusion that knowledge of the topic of conversation adds to the successful visual comprehension of speech. An experiment in lip-reading tests extending over a period of five years was reported in 1940 by Heider (6). Test administration was conducted by means of motion pictures. The tests "were found to be highly reliable" (6, 151-152).

The writer to date knows of no standardized test in which an individual's achievement in visual-speech comprehension may be ascertained

[1] Read before the American Speech Correction Association, Chicago December 29, 1942.

and compared with that of another. A possible and reasonable explanation for the lack of objective measurement may be found in the existence of individual differences in visible speech manifestations exhibited by various speakers. Comparable results are impossible to obtain on a test spoken by two speakers of widely differing visible speech characteristics (8). Indeed, comparable results may likewise be difficult to obtain from subsequent tests made by the same speaker. Such a test lacks the factor of constancy of visible speech pattern without which an accurate test cannot be built.

II. Research Leading to the Present Investigation

In the attempt to find a means of developing a test with reasonable objectivity and reliability the present investigation was anticipated by research, which, in September, 1930, led to the development of the visual-hearing method[2] of instruction in visual-speech comprehension by means of motion pictures. By employing a silent motion picture of a speaker, this method provides a control of the following factors: the constancy of speech movements, the visibility of speech presentation, and the degree of distance from the speech source—all of which affect the efficiency with which inaudible speech is visually comprehended.

This same cinematographic technique has been employed in the construction and administration of tests of visual-speech comprehension, the first of which the author used with university students in November, 1930. Other tests soon followed, each designed to measure a specific skill involved in visual hearing. Of these the following are briefly summarized:

Test I:

A motion-picture test in which a speaker gives fifty sentences composed of phonetic elements which are characterized by visibly perceptible movements, e.g.,

1. The labial and labio-dental consonants
2. The vowels which show definite oral configuration

Test II:

Fifty sentences composed of phonetic elements which are characterized by less perceptible visible movements, e.g.,

1. The palatals and velar consonants, etc.
2. The vowels which show more or less indefinite oral configuration

Test III:

A short story which is related by a speaker. The students are directed to attempt a detailed written reproduction. The responses are scored according to their ideational content, following the familiar technique used in tests of logical memory (3); i.e., one point for each idea correctly expressed (9).

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[2] A laboratory method in which a student is required to make a visual interpretation of material as spoken on a silent screen. This method comprises a complete series of lessons of progressive difficulty. Each lesson consists of motion pictures of a different speaker making an oral presentation of the lesson content. The visual-hearing method was originated by the author at the suggestion of Professor G. O. Russell, who also directed the early photographic technique. It has been in use in the author's classes at Ohio State University since 1930.

TEST IV:

A more advanced form of Test III, involving more complex sentence structure and demanding a longer attention span.

TESTS V AND VI:

Composite tests (9) in which a student's visual comprehension of speech is ascertained in skills of a varied character requiring such responses as: a verbatim repetition of a sentence, answering questions, supplying the name of a person or object described, and other similar tasks.

III. THE PRESENT INVESTIGATION

The present research has been in progress since 1932. It is exploratory in character. Its purpose is: to set up a technique capable of providing an objective measurement of visual-hearing achievement; to construct more objective visual-hearing tests by means of motion picture film; to administer them to large numbers of acoustically handicapped children; to ascertain the degree of practicability with which such a test might measure the visual-hearing achievement of young deaf and defective-hearing children; and to attempt, if possible, to establish norms for determining the visual-hearing accomplishment of children at various age levels.

IV. THE VISUAL-HEARING TESTS

Two simple tests were constructed to be used experimentally in this study. Test I, Form A, and its alternate, Form B, were designed to determine a young pre-school deaf child's ability to recognize the visible kinaesthetic speech pattern set up when five simple test words are spoken individually; and to translate these visible movements into verbal concepts. Test II, Form A and Form B, included ten words of increasing visible and experiential difficulty intended to measure achievement of a slightly higher level. Nouns were used in both tests. They are here listed:

TEST I:

Form A: flower, cow, top, ball, fish
Form B: baby, car, cat, cup, shoe

TEST II:

Form A: woman, boat, fork, man, comb, dog, boy, table, chair, girl
Form B: sheep, cap, book, muff, spoon, coat, knife, glove, glass, horse

V. THE CINEMATOGRAPHIC TECHNIQUE

The next step in the experimental procedure was the cinematization of the test content. The plan was to present in a preliminary film a dramatization of the test technique which would show the child being tested precisely what he is expected to do. The successive steps in the cinematographic procedure are here outlined:

FIRST STEP

A motion picture scene is shown in which a speaker and two

deaf children are seated at a table, on which may be seen concrete objects illustrating the five test nouns. Holding up each object in turn, the speaker pronounces its name, turning successively in profile as she speaks to the child on either side, and finally speaks a third time directly into the camera.

SECOND STEP

1. The speaker, without indicating the object, speaks each of the five nouns in altered serial order; the children in the picture respond by holding up each object as it is spoken.

2. A pictorial chart, a facsimile of the test blanks used in the test proper (in the succeeding step), is then shown. The pictured children are seen making a large cross on the picture representing the spoken word called for by the speaker.

THIRD STEP

This is the test proper. The speaker appearing alone gives the same five nouns in varied order, speaking directly into the camera. This gives the effect of addressing herself personally to the children being tested. Each spoken word is preceded by a number which corresponds to the numbered row of pictures on the test blank and which contains the illustrated test word. The testees' response is a large cross drawn on the picture which for them objectifies the words pronounced by the speaker.

The cinematographic technique for Test II is the same as for Test I. Both tests are on 16-mm. motion-picture film.

VI. THE CINEMATOGRAPHIC ADMINISTRATION OF VISUAL-HEARING TESTS

The administration of the visual-hearing tests used in this experiment was under all circumstances carefully anticipated by judicious planning and meticulous insistence on uniformity of detail.

These two experimental tests were given over the period from 1932 to 1940. A total of 850 children between the ages of four and sixteen participated in the experimental testing program either in its entirety or in a substantial part. Over 700 were tested on the alternate forms of Test I and Test II. The tests were administered to deaf pupils of two large state residential schools, three endowed or privately financed residential schools, and two large day schools for deaf and hard-of-hearing children. The writer visited each school and personally conducted all tests.

Analyses of the test data disclosed gratifying results in so far as the cinematographic testing technique is concerned. Analyses suggest, moreover, that these tests possess some reliability.

There is evidence of a reasonable relationship between the test words of both Test I and Test II. The clustering of scores for both tests on the upper score levels, in the attempted computation of coefficients of correlations for both the entire population and for a reduced sample, suggests inaccuracy or inappropriateness of these measures as applied to these data.

There is reason to assume that such factors as the small number of testees on the five to seven-year levels, insufficient number of test items, and predominance of high scores (on the eight-year level and above) tend to lower the reliability of Test I and Test II.

At this point of the experiment it seemed necessary and advisable to develop a new test embracing a greater variety of items and a wider range of difficulty.

VII. Description and Discussion of the Revised Test

The construction of a visual-hearing test more comprehensive in scope than either of the original tests was accomplished by retaining all of the test items of Tests I and II, fifteen in number, in altered sequence. To these were added fifteen new nouns. Ten of the latter were presented cinematographically and visually following the original technique. The remaining five nouns were included in the test proper and the children were required to attempt a visual-speech comprehension of these items with no prefatory clue to their objective identity. This inclusion of items minus their objective presentation was intended as a stimulus for more highly discriminative performance. This revised and extended test with its alternate forms is discussed as Test III, Forms A and B.

The items for both test forms, together with their pronunciation according to the symbols of the International Phonetic Association, are shown in Chart I and Chart II.

The items for this test were selected for their conformance to these specifications: (1) their occurrence in the first three thousand of Thorndike's word frequency list; (2) their place in building vocabulary for language comprehension of young deaf children in the early grades of schools for the deaf and in classes for hypacusics; (3) their inclusion of the most frequently occurring consonant and vowel sounds; (4) the photogenic qualities of the concrete objects which symbolize the verbal concepts; (5) the freedom of the test words from visual ambiguity of meaning; (6) the distinct visible speech manifestations of the phonetic elements of which the test nouns are composed; (7) lack of homophenity (visible similarity) in test words except where deliberately planned so as to test superior visual discrimination; and (8) their place in the life experiences of children, through toys, pictures, or actual objects.

Test III, Forms A and B, was administered to 187 pupils in a large residential school. Of these there are complete data for 138. Analyses and conclusions herein presented are based upon this number. Eliminations were made on the basis of age and incomplete data. All pupils between the chronological ages of six and twelve for whom there are complete data have been included in this study.

Discussion, analysis, and evaluation of test results must be considered in terms of somewhat limited material. One must take into account, however, the existence of the comparatively few acoustically handicapped pupils in schools for the deaf, in comparison with the extremely large numbers of hearing children in the public schools. The extreme distances between schools for the deaf (in many instances but one in each state) must likewise be considered in contrast to the many schools in a city school system. Furthermore, a large accumulation of data is not a necessary criterion on which to base the success of a research problem.

The scores made by the entire population of 138 children between the chronological ages of six and twelve years, inclusive, and the diminished population of 86 children, six to ten chronologically, were studied with regard to the presence or absence of relationship between individual scores on the two forms of the test. It seemed practicable to ascertain to what extent those making a superior performance on Form A, par-

CHART I

FORM A

No.	Noun	Phonetic Transcription	No.	Noun	Phonetic Transcription
1	top	tɑp	16	man	mæn
2	cow	kɑʊ	17	chair	tʃɛɹ
3	ball	bɔl	18	fork	fɔɹk
4	flower	flɑʊəɹ	19	boy	bɔɪ
5	fish	fɪʃ	20	table	tebl
6	nose	noʊz	21	girl	gɜɹl
7	orange	ɔrəndʒ	22	finger	fɪŋgəɹ
8	thumb	θʌm	23	key	ki
9	box	bɑks	24	bottle	bɑtl
10	candy	kændɪ	25	cracker	krækəɹ
11	ear	ɪɹ	26	*bathtub*	bæθtʌb
12	boat	boʊt	27	*slipper*	slɪpəɹ
13	comb	koʊm	28	*hairbrush*	hɛɹbrʌʃ
14	woman	wʊmən	29	*sweater*	swetəɹ
15	dog	dɔg	30	*birdcage*	bɜɹdkedʒ

CHART II

FORM B

No.	Noun	Phonetic Transcription	No.	Noun	Phonetic Transcription
1	baby	bebɪ	16	banana	bənænə
2	arm	ɑɹm	17	glass	glæs
3	shoe	ʃu	18	spoon	spun
4	car	kɑɹ	19	muff	mʌf
5	eye	ɑɪ	20	pencil	pensɪl
6	cup	kʌp	21	knife	nɑɪf
7	mouth	maʊθ	22	watch	wɑtʃ
8	cat	kæt	23	cookie	kʊkɪ
9	flag	flæg	24	towel	taʊəl
10	soap	soʊp	25	glove	glʌv
11	sheep	ʃip	26	*stocking*	stɑkɪŋ
12	horse	hɔɹs	27	*basket*	bæskɪt
13	cap	kæp	28	*toothbrush*	tuθbrʌʃ
14	book	bʊk	29	*umbrella*	ʌmbrelə
15	coat	koʊt	30	*rabbit*	ræbɪt

alleled that performance on Form B; conversely, to what degree those making low scores on Form A gave similar performances on the alternate test form. These scores revealed a higher degree of relationship between the two forms of Test III than those for either of the earlier tests.

This relation is further studied by computing the coefficient of correlation. The scores obtained on Test III, Form A and Form B, by 138 children, ages six to twelve years, show a Pearson product moment correlation of .926±.0084. For the scores of 86 children, six to ten years old chronologically, the computed r is .954±.007.

These high correlations give evidence that Test III possesses some reliability as an instrument for estimating the visual-speech comprehension achievement of acoustically handicapped children between the chronological ages of six and twelve years. However the concentration of scores on the higher score levels renders the ordinary coefficients of correlation inappropriate as means of statistical computation. Nevertheless, it is believed that sufficient evidence of relationship is present to indicate that, with future refinement and extension, the test would show definitely high reliability. The author plans to extend this study.

VIII. Conclusions

Critical analyses of this experimental investigation tend to support the author's belief that the main objective of this study has been achieved. This experiment does not undertake to develop a test of proved high validity and reliability, although it is hoped that these characteristics may exist to a satisfactory degree. Concentration of effort is confined, rather, to the evolution of a new technique capable of providing a more objective and more adequate measure of visible-speech comprehension.

The following statements, conclusions and recommendations are prompted by the analyses of the accumulated data and their interpretation in terms of the practicable aspects of this contribution to research on the problem of the acoustically handicapped.

1. The visual-hearing or cinematographic technique of administering a test of visual-speech comprehension provides reasonably objective measurement. It controls the variability of visible speech movement by presenting spoken discourse on a silent screen; it also controls such variables as distance from the sound source and rate of speech.

2. A test of visual-hearing achievement may be successfully administered by substituting a cinematographic technique for the usual face to face teacher-pupil test used in so-called lip-reading or speech-reading tests.

3. The earliest chronological age at which a cinematographic visual-hearing test may be successfully administered is five years, according to results of Test I, Forms A and B, although some four-year-old children score creditably. On Test III, Forms A and B, six-year-old children score successfully, while some five-year-olds score creditably.

4. As a measuring instrument and as used in this experiment, Test I, Form A and Form B, is most directly applicable to the age levels five to seven, inclusive; Test II and its alternate forms are suitable for ages seven to ten; and Test III is adaptable to the age span of six to twelve, but is more discriminative when used to measure children six to ten years chronologically. These conclusions are based on somewhat limited data.

5. The computed coefficients of correlation for all three visual-hearing tests suggest that they possess a certain degree of reliability as measures of visual-hearing achievement.

6. The ease, rapidity, and accuracy with which large groups of children understood the test directions, and executed the task set by the tests, indicate that the technique employed in this experiment makes for practicable and effective measurement of visual-hearing achievement.

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GROUP-TESTING OF HEARING

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I.

Many surveys of the hearing of school children are being prosecuted these days; and, in the conducting of these surveys, much mass-testing and sorting is undertaken to shorten the routine of the testing programs. Hence we are faced with the very practical question: what constitutes an efficient group screening test? In theory, this question can be answered very simply. An efficient group screening test consists of any testing technique that, with the least expenditure of testing time, discovers in the group under survey all who are deaf or hard of hearing.[2]

That is a simple answer; but the catch in the answer is hidden in the phrase *all who are deaf or hard of hearing*. Most of us agree as to what deafness means, but we have such different notions about the hard of hearing, that our original statement needs some amplification.

The technique to be employed in a group test to sort out those who need to be given careful individual audiometric study, to determine if they be deaf or hard of hearing, depends upon the basic purpose of the hearing survey. Many a survey, employing perfectly good methods, has failed to achieve satisfactory efficiency, merely because the methods were not suited to the purposes of the survey. A very good carpenter's drill fails if employed in a metal-working shop. The purposes of a hearing survey are, or may be: (1) Pre-medical, (2) pre-educational, and (3) both pre-medical and pre-educational.

II.

1. The pre-medical survey is one in which the purpose is to discover all the chilren who are in need of study by, and help from, the otologist, or ear-doctor. Just as many diseases of the eye do not seriously interfere with reading, so many diseases of the ear do not, at first, at least, interfere seriously with the hearing of speech. A screening technique, therefore, that tests merely the comprehension of speech is only partially efficient in a survey whose purpose is pre-medical. The pre-medical screen test should explore the acuities throughout the entire range of frequencies used in speech. Two procedures useable in such a screening are: (a) a sweep test with the in-

[1] President of the National Association of Teachers of Speech. Professor West read this paper before the American Speech Correction Association, December 29, 1942.

[2] This paper is intended to give the reader general information about group testing of hearing and to discuss the general principles of the subject, not the details of procedure.

dividual audiometer, (b) a phonograph test, using recordings of pure tones, or of "wobbulated"[3] tones.

2. The pre-educational survey is one that attempts to discover the children who, for any reason, are impaired in their perception of speech, in order that these children may be handled properly in their educational careers. Some of these children will have no impairment of auditory acuity and no disease of the peripheral organs of hearing; but most of them will have some hearing loss. Since this type of survey is concerned primarily with the ability of the child to comprehend language, the screening test to be employed should be a speech test. The best technique for such a test is one employing phonographic recordings of sentences, words, or numbers.

3. The combined survey aims to discover (a) all those children who at the time of the test have difficulty in hearing or who may in the future have difficulty, and (b) those who have difficulty in understanding spoken speech, though they suffer from no reduction of auditory acuity. These two groups are in large measure overlapping, though to assume that they are completely so is dangerous. A screening technique that is efficient in discovering only one of these groups will often fail in accomplishing the full purpose of such a survey, and will leave undiscovered in every large group either a few children who suffer from diseases of the ear, or a few who are really deficient in their understanding of language but who are erroneously thought to be mentally retarded, "lazy" or emotionally mal-adjusted.[4] Obviously the screening techniques for surveys having both pre-medical and pre-educational objectives should include both tone tests and word tests. Since the word tests are most efficiently given through phonograph records, it is most feasible to administer the tone tests with the same set-up.[5]

[3] A "wobbulated" tone is one that varies in pitch many times a second, as, for example, a tone that is constantly modulated in pitch from 128 to 256, at the rate of 30 cycles of modulation per second.

[4] Recently I heard about two surveys conducted independently in two adjoining counties in which two radically different screening techniques were employed: in area A, the Maico sweep test; and in area B, the Western Electric number test. So far, so good; but in area A the professed purpose was to discover those children who were educationally handicapped in their hearing, while in area B, the purpose was to discover those who should be referred to the otologist. Such a complete mis-matching of techniques and purposes is to be excused now on the basis of ignorance; but the time will come when it will be regarded as professionally inexcusable and as a culpable waste of tax funds.

[5] A practical test is made up as follows: Right ear, two series of numbers of diminishing intensity, and two series of tones, one of 2000 cycles and one of about 4000 cycles, of diminishing intensity; left ear, the same except that the tones are presented first, and of course the numbers and tone tests are altered so as to obviate the possibility that the children may remember the correct responses. In this type of combination test the number of items in the tone part of the test should be exactly the same as in the number part.

III.

The next question to be answered, in setting up a screening test to sort out the children who should be further tested individually, is how strictly should the screen tests be scored to make sure that all the children who should be uncovered have actually been found by the screening process. Many variable factors (to be treated below) make it impossible to fix an absolute line of failure on the basis of which test papers can be scored. Then, too, the strictness with which the papers are scored will depend upon the ultimate objectives of the survey. If the object of the survey is to uncover only the severest cases of disease of the ear, or the severest cases of those educationally handicapped in their perception of speech, then the screen test papers can be scored very leniently. If the object includes the finding of all cases of beginning auditory impairment or all cases of slight impairments of the perception of speech, then the papers must be scored very strictly and many borderline children must be retested. This retesting takes time, and the more time consumed the less efficient the screening; but, without this retesting, many children may slip through the screen, who should be given later individual tests; and the more of such children who slip through the screen, the less efficient the screening. The strictness of the scoring should thus be gauged, in actual field experience, by employing a small sample, or control group, all of whom are given screen and individual tests. The scoring of the screen tests can by this means be adjusted so that they will uncover, with a minimum expenditure of time, a maximum number of the type and degree of cases that are to be sought for in the survey. The "drilling of this test-well" will in the long run greatly increase the efficiency of the survey.

Now to come back to the original question as to how strictly to score the screen tests. It is obvious from what has been said above that any scoring instructions given by the manufacturers of the test material must be modified to fit the conditions and purposes of the survey, and that no specific recommendation can here be given as to the proportion of children who should be retested after screening. We can here give only the maximum percentages to be retested if the objective of the survey is to uncover all cases in need of further study, even the minor and the beginning cases of auditory impairment:

(1) In a pre-medical survey, using the phonograph recordings of tones, retest the 40 per cent who make the poorest scores. If the sweep test on an individual audiometer is used, retest all those whose losses are greater than 20 per cent at any point or points on the audiogram.

(2) In a pre-educational survey, using phonograph recordings of speech, retest the 40 per cent who make the poorest scores.

(3) In a combination type of survey, using the combination method described above, retest the 50 per cent of the children making the poorest combined scores.

In two separate surveys using the same tests and the same criteria of scoring, the percentages of those retested may greatly differ. Suppose in both surveys 15 failures[6] on the number test was taken as the failure line. In one survey, it might be found that 50 per cent of the children would require retesting and, in another, only 35 per cent. What are the factors that make for these variations between surveys?

The factors of error that make for too high scores are:

(1) Cheating
(2) Intelligent guessing of the numbers spoken.
(3) Special acuities in an ear otherwise defective.
(4) Phones out of callibration.
(5) Wrong test for the purposes of the survey.

The factors that make for too low a score are:

(1) Noisy testing rooms.
(2) Fear and excitement on the part of the children.
(3) Poor intelligence.
(4) Youth of the children tested (First and Second graders are likely to get poor scores).
(5) Phones out of callibration.
(6) Poor administration of the test.
(7) Indifference on the part of the children tested.
(8) Wrong test for the purposes of the survey.

IV.

The question is often raised as to the relative advantages, in time consumed, of the group phonograph test and the sweep test employing the individual audiometer. It is obvious, from what has been said above, that in some surveys, in which it is unsuited to the objectives of the survey, the sweep test cannot be used, regardless of how rapidly it may be administered. In a pre-medical survey, however, the sweep test may be seriously considered as the technique to follow. The time-consuming tasks in the accurate administration of these two tests are (figures given on the basis of a group of 25 children):

(1) Sweep testing:	
(a) Setting up instrument	10 min.
(b) Testing, 2 minutes per child	50 min.
Total	60 min.
(2) Phonograph testing:	
(a) Setting up instrument	15 min.
(b) Testing	15 min.
(c) Scoring papers	15 min.
(d) Retesting	10 min.
Total	55 min.

[6] Sometimes the number test is scored on the basis of the level in each series of numbers of diminishing intensity at which the child makes his first definite failure. In either case the scoring method must be applied with discretion and discernment so as to distinguish between those failures that are due to auditory conditions and those due to distractions, confusions, and misunderstanding of the test instructions.

We can see from these figures that there is very little difference in the actual time consumed in the two techniques. The time advantage in favor of the group method is a slight one. There is another difference, however, that is much more important than this one of the time consumed, viz., the wear and tear on the one who does the testing. Few operators can sweep test all day at the rate of 30 children an hour; and even those who can keep up that pace slip seriously in their accuracy long before they have reached the 180th child. With the group testing, however, the routine is sufficiently broken so that the operator does not seriously suffer from fatigue. Then, too, with the group test, the actual presentation of the test tones is done by machine, thus relieving the tester of responsibility of thousands of separate decisions,[7] during the course of his day of testing.

[7] If the tester, using the sweep technique, tries each frequency only three times on each ear, that means 42 separate decisions just for the giving of the tones to one child, 1260 decisions per hour, and 7560 decisions in a six-hour day. Few workers can stand that strain; and these figures are definitely minimal.

MEMO

The deadline for the December issue of the *Journal* is October 1. Manuscripts to be considered for publication in December will be those received in the editorial office before that date. Deadlines are January 1, April 1 and July 1, for the March, June and September issues, respectively.

ABSTRACTS OF CURRENT ARTICLES

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The following journals, pamphlets, and abstracting services contain recent literature dealing with hearing, deafness, and related speech problems that may be of special interest to readers of the *Journal:*

1. Journals: The *Volta Review; American Annals of the Deaf;* The *Lip Reader; Annals of Otology, Rhinology and Laryngology;* The *Laryngoscope; Archives of Otolaryngology;* and the *Journal of Laryngology and Otology.*

2. Pamphlets: *Listed Pamphlets* and Gardner, W. H., *Instructions for Conducting Audiometer Tests,* American Society for the Hard of Hearing, 1537 35th Street, N.W., Washington, D. C.; *The Oregon Program for Conservation of Hearing,* The Oregon State Board of Health, Division of Maternal and Child Health, Portland, Oregon; and *A Program for Hearing Conservation,* Bureau for Handicapped Children, Department of Public Instruction, Madison, Wisconsin.

3. Abstracting services: *Child Development Abstracts,* Society for Research in Child Development, National Research Council, Washington, D. C.; *Speech Abstracts,* Clyde W. Dow, Massachusetts State College, Amherst, Mass.; and *Medical Journal Abstracts,* E. R. Squibb Company, Brooklyn, N. Y.

Clarke School for the Deaf. Studies in the psychology of the deaf, *Psychol. Monog.,* 1940, **52**, 153.

These six studies are the result of psychological research begun in 1928 at the Clarke School for the Deaf. In the first study it is claimed that language is not essential for organized conceptual thought, at least during its first stages, that the world of the young deaf child is already organized beyond the perceptual level, and that this organization closely follows that of speaking people.

The second study is a comparison of color sorting behavior of deaf and hearing children to see whether the performance of deaf children resembles that found by Gelb and Goldstein for aphasics. The results indicate that the thought of the deaf child, at least in regard to these color sorting tasks, before he begins to use conventional language is essentially similar in form to that of the hearing child, and that it is not disturbed by imperfect or inadequate language concepts.

The results of the third study which examined the phonetic symbolism of deaf children indicated that the sensory data of the deaf are so far differentiated that it is possible for them to feel the symbolic value of spoken words much as hearing people do.

Study number four, a comparison of sentence structure of deaf and hearing children, shows that the sentences of the deaf were shorter and less complex, and in general their performance resembled that of less mature hearing children.

The fifth experiment was a study of the spontaneous vocalization of young deaf children. It was observed that, with the exception of five consonants, the range of vowels, diphthongs, and consonants recorded for the group of deaf children included all those of standard English speech.

(Continued on Page 296)

THE REALITY OF THE ZERO REFERENCE LINE FOR PURE TONE TESTING[1]

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I. INTRODUCTION: THE PROBLEM

After having checked over audiograms which college students who were enrolled in courses in hearing have submitted during the past several years, the writer has been interested in the exceedingly high percentage of these hearing charts which registered acuity thresholds falling almost exactly on the zero line or line for "normal hearing." He has observed this same characteristic concentration of thresholds on audiograms made by teachers and school nurses who do pure tone testing in the public schools of Pennsylvania. He has also noted a general tendency of school nurses and teachers who do hearing testing to refer to a threshold for a particular frequency which happens to fall at a level of possibly 10 db below this normal line as representing a "10 db loss in hearing." The possibility that the zero line on the audiogram often comes to represent a falsely rigid symbol of normalcy presents itself.

TABLE I. OBSERVED AND THEORETICAL DISTRIBUTIONS FOR MEASUREMENTS OF AUDITORY ACUITY BY AIR AND BONE CONDUCTION ON 2,484 MASTOID BONES OF 1,242 PERSONS WHOSE AIR CONDUCTION AUDIOGRAMS FOR BOTH EARS DID NOT EXCEED A VARIATION OF 20 DB ON EIGHT TONES.

HL in db	Audiofrequency in cycles: air conduction N=2,484 ears							
	64	128	256	512	1024	2048	4096	8192
—20	----	----	----	----	----	3	2	1
—15	10	6	----	1	18	40	5	5
—10	54	55	6	13	97	190	39	58
— 5	420	297	63	86	478	539	201	224
0	797	696	365	434	873	784	479	493
5	705	811	752	883	672	589	706	723
10	346	445	766	724	252	270	651	594
15	130	142	396	239	83	64	298	294
20	21	30	114	85	11	5	96	79
25	1	2	22	18	----	----	7	13
30	----	----	----	1	----	----	----	----
35	----	----	----	----	----	----	----	----
40	----	----	----	----	----	----	----	----
45	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----
M	2.7	3.7	8.0	7.3	1.5	0.6	6.1	5.7

The normal reference line used in plotting hearing charts with the Western Electric pure tone audiometer was developed

[1] Read before the American Speech Correction Association, Chicago, December 29, 1942.

from the averages of threshold acuity measurements on 82 ears of 41 adult employees of the Bell Telephone Laboratories. The validity of this generally accepted reference level was measured in the *National Health Survey* (1), and it was concluded that the scale was properly adjusted to average normal hearing on the four tones 64, 128, 1024, and 2048, but that tones on 256, 512, 4096, and 8192 cycles were approximately 5 db too weak. Table I (1, 3), a duplicate of part of a table included in *National Health Survey, Bulletin 4,* shows that among persons who have normal hearing one may expect to find a considerable dispersion of acuity thresholds for the various frequencies from the zero reference line.

When audiograms representing a large number of subjects fail to show a reasonable dispersion of thresholds, one may well wonder exactly how precise a measurement of hearing the pure tone audiometer test constitutes. When these audiograms follow quite closely a more generally used norm, rather than a corrected one which is probably the more valid, a further doubt of the absolute objectivity of the pure tone test arises.

II. Procedure

With the hypothesis that the testing technique would have something to do with the tendency the testers showed to get thresholds which were too close to the normal line, the following experiment was set up. Forty-one teachers and nurses who were learning to use the pure tone audiometer were divided into two groups. Each group, one made up of twenty and the other of twenty-one individuals, received different instructions in the use of the equipment. After becoming familiar with the audiometer panel one group was intructed to watch the attenuation dial as each adjustment was made. The second group was instructed to observe the dials only when they were first being set to begin the testing of one frequency and then when the threshold level was read for recording on the audiogram. The complete attention of the second group was on the subjects being tested, these testers relying upon sensory controls other than vision to adjust the attenuation.

Each ear on 100 subjects was tested twice, once by an individual in the first group of testers and once by an individual in the second group. Fifty of the subjects were tested first by one method and another fifty were tested first by the second method in order to distribute evenly the effects of practice between the two groups. Five additional subjects were tested only by the first method since there was an additional number in one group of testers. Two Western Electric

6 A audiometers were used for all of the testing. Both tests on each subject were made on the same audiometer.

III. Results

Table II represents the distribution of thresholds reached when the individuals doing the testing watched the audiometer panel during the testing procedure. Table III represents the distribution of the thresholds found with the same subjects when the persons who were doing the testing traced down the thresholds without watching the callibration on the attenuation dials. Comparing the two tables one notes definite concentration of thresholds at the zero line in Table II and a considerable dispersion of the thresholds in Table III.

TABLE II. Distribution for Measurement of Auditory Acuity on 210 Ears When Individuals Testing Watched the Audiometer Panel During the Testing.

HL — db	128	256	512	1024	2048	4096	8192	9747
—10	1	----	1	8	15	11	1	2
— 5	23	11	13	34	31	38	21	19
0	108	99	121	135	137	140	117	101
5	67	86	65	30	26	21	62	62
10	9	13	8	3	1	----	9	25
15	2	1	2	----	----	----	----	1
20	----	----	----	----	----	----	----	----
M	1.36	2.48	1.71	—.33	—.79	—.93	1.36	2.19
M.D.	2.98	2.1	2.43	2.55	2.12	1.93	2.48	3.29

The subjects were not tested a third time and so there is no verification that the thresholds represented in either Table II or III are the correct ones; however, those represented in Table III more closely resemble the data from which a corrected normal reference level was derived; whereas those repre-

TABLE III. Distribution for Measurement of Auditory Acuity on 200 Ears When Individuals Testing Did Not Watch the Audiometer Panel During the Testing.

HL — db	128	256	512	1024	2048	4096	8192	9747
—10	4	1	1	9	12	6	3	5
— 5	21	6	7	34	47	28	24	20
0	55	49	29	80	59	43	47	44
5	72	63	89	51	55	71	63	55
10	39	46	53	18	14	47	51	61
15	8	29	16	7	13	5	11	11
20	1	6	5	1	----	----	1	4
M	3.73	6.45	6.35	1.50	1.28	3.50	4.30	4.90
M.D.	5.20	6.85	6.84	4.35	4.88	5.50	5.80	6.40

sented on Table II show a suspiciously artificial concentration. The tables do demonstrate that by varying the testing technique different thresholds are arrived at in the same individuals, and that using a technique which keeps the tester conscious of a sound pressure level and its relationship to a norm seemed to result in a gravitation of those thresholds toward that norm. Using a technique whereby the tester is not too fully aware of sound pressure levels while he controls the attenuation produced a more normal distribution of thresholds.

REFERENCES

1. *National Health Survey, Hearing Study Series, Bulletin 4.* Washington, D. C.: U. S. Public Health Service, 1938.

THE 1943 CONVENTION

The 1943 convention of the American Speech Correction Association is scheduled to be held jointly with that of the National Association of Teachers of Speech on December 28-30 at the Commodore Hotel in New York.

A full program is being planned. The special emphases of the 1943 program will be (1) technical and scientific papers on speech pathology, (2) papers dealing with the inter-connections between speech correction and related fields, and (3) reports and analyses of speech correction activities connected with the war.

The Program Committee is proceeding on the assumption that the 1943 convention will be held as scheduled, although final decision to hold the convention has not been made by the Council of the Association. At the time this notice is being written a poll of the voting membership of the Association is in progress. Final decision will depend upon the results of this poll and upon general feasibility in the light of war conditions. When a decision has been made, the membership of the Association will be notified. Meanwhile members are urged to complete their plans to attend the 1943 convention so that they will be prepared to make the necessary reservations as soon as notification arrives.

THE PROGRAM COMMITTEE.
Raymond Carhart, chairman.

THE EFFECTS OF NOISE AND CONCUSSION ON HEARING[1]

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I.

One of the uncontrolled and poorly understood by-products of modern civilization is noise. As we develop more and more powerful machines for industry or warfare we create greater and ever greater sources of noise. We have known for the past one hundred years that noise is injurious to the ear, but it is only in the past decade that we have learned something of the exact nature of the acoustic phenomena involved and the resulting ear damage. The audiometer has been an important tool in helping to define the clinical entity of acoustic trauma. Audiometric studies have been made on large numbers of individuals who have had a definite history of exposure to acoustic insult. Furthermore, audiometric studies have been carried out on normal subjects exposed for short periods to specific industrial noises. Many noises are now known to be injurious to the ear.

While in time of peace large numbers of individuals were exposed to these traumatizing noises, little interest was aroused about the matter. People in industry accepted noise as an unavoidable nuisance that had to be put up with in the business of doing a job and earning a living. The boiler-maker expected to get deaf. The operator of a large metal stamping machine exhibited his deafness as a proof of experience at his job. The rapidly advancing science of acoustic physics is beginning to be applied to the problem of noise reduction. This control of noise can be accomplished in three different ways: altering the noise at its source (silencing motors), altering the noise by changing the surroundings (sound-absorbing materials in the room), direct protection of the ear itself (ear obturators). The war has aroused widespread interest in acoustic trauma because more and more people are exposed to the great noises associated with modern warfare. This is true now when there are such huge armies and particularly because great numbers of civilians are engaged in war industry or may be exposed to the noises associated with bombing.

II.

The principal characteristic of the hearing loss resulting from noise of any source is that the high frequencies are the first to be involved. It is now generally recognized that the

[1] Read before the American Speech Correction Association, Chicago, December 30, 1942.

earliest manifestation of acoustic trauma is a drop in hearing for frequencies around 4000 cycles. This loss obtains for air and bone conducted sound, and in general the injury from almost all noise is in the perceptive or neural mechanism of the ear. Only under special circumstances, to be described later, there may be a superimposed lesion of the conducting system. The early manifestations of acoustic trauma (drop in threshold around 4000 cycles) may be unchanged even after many years of exposure. As the trauma progresses, hearing for still higher frequencies may be affected. Yet even at this stage, the hearing loss is not noticed by the subject. The reason for this lies in the fact that we use our auditory systems primarily for hearing the spoken voice and this function is not appreciably affected by loss of hearing frequencies above 4000 cycles. Attention was first attracted to this early manifestation of acoustic trauma about 10 years ago when the audiometer was widely used for routine hearing tests. Among large numbers of normal subjects an unexplained abrupt high tone loss in the audiogram at about 4096 cycles was often found. Careful questioning often brought out a definite history of exposure to loud noise. This early stage of acoustic trauma usually escapes recognition because the subject is not aware of it and hence does not consult an otologist. As exposure to acoustic insult continues, hearing for the frequencies below 4000 cycles becomes impaired and then difficulty in hearing the spoken voice becomes noticeable, especially the whispered voice. The hearing loss from acoustic trauma is not progressive if the subject ceases to be exposed to the stimulus. But tinnitus, which often accompanies the hearing impairment, varies as to duration and intensity and may endure long after the acoustic insult. During the active stage of prolonged exposure the auditory threshold may fluctuate, depending on whether the examination is carried out immediately after exposure (when impairment is more marked) or after a period of rest (when only the basic impairment can be demonstrated).

III.

Many factors influence the degree of hearing loss from acoustic trauma:

1. The total time of exposure.
2. The length of exposure in each period.
3. Loudness of the sound stimulus.
4. The age of the subject.
5. Constitutional factors.
6. The character of the sound stimulus. This is important for several reasons. Sudden, loud sounds occurring less frequently than 5 per second will produce discrete contraction of the middle ear muscles. These muscles on contraction stiffen

the ossicular chain, thus reduce the amplitude of their oscillation to sound and in this way protect the delicate end organ in the cochlea. But this contraction is preceded by a definite latent period, of about 10.5 milliseconds, during which time the auditory apparatus is not protected from the stimulating sound. Repeated contraction preceded by repeated latent periods result in greater damage to the ear than exposure to sustained sound.

Sounds initiated by explosions, gunfire and the abrupt contact of two metals are due primarily to exceedingly brief compression pulses of enormous magnitude. The intensity of these explosive sounds is not easily determined because the pressure disturbance lasts about 1/1000 second. The commonly used noise level meter is unsuited for measurement of such transient acoustic phenomena.

7. The use of protective devices. Their effect is a differential one—they usually block out high frequencies more adequately than the low frequencies.

8. Exposure to noise in an enclosed space, where reflection of sound adds to the trauma, or in the open.

9. The position of the head with respect to the sound source. The head is an effective shield for high frequencies and explosive sounds. The ear facing the explosion will receive the brunt of the damage while the ear on the opposite side of the head will escape because of the shielding effect of the head.

10. The relation of the frequencies of the traumatizing sound to the resultant hearing loss. No uniform hearing loss, such as an isolated dip in the threshold curve at 4096 cycles, can be obtained by traumatizing the ear with various pure tones. For some unexplained reason the maximum drop in the threshold curve is an octave above the frequency of the fatiguing tone. Low frequencies are much less traumatizing than high frequencies; i.e., you can expose a subject to a 64 cycle tone at 100 db intensity for one hour and find no depression in the audiogram immediately after exposure. A similar exposure to a 1024 cycle tone produces a localized depression in the audiogram of 40 to 60 db that requires three days for complete recovery.

IV.

What part of the perceptive mechanism of the ear is affected by exposure to acoustic insult? This perceptive mechanism consists of the organ of Corti, spiral ganglion, primary acoustic nucleus, lateral lemniscus, auditory cortex and radiations. Experimentally it is possible to produce a localized disruption of the organ of Corti by exposing an animal to a loud pure tone. Histologic examination of the temporal bones of individuals showing an abrupt high tone loss during life

shows degenerative changes in the organ of Corti in the basal turn of the cochlea and of the adjacent spiral ganglion cells. Reversible changes of the auditory mechanism on exposure to moderately loud sound (producing a temporary depression of function or auditory fatigue) appears to be localized in the higher centers. More severe acoustic stimuli temporarily depress function both in the peripheral and in the central mechanism.

The reaction of the ear to concussion deserves separate description because of the special factors involved. Concussion is the word used to describe the effects of the pressure wave produced by an explosion. This is a peculiar asymmetrical wave that develops when the solid or liquid explosive is set off and suddenly changes into gas. Usually this change takes place in about 1/100,000 second. The molecules of the air are compressed by this abrupt change in volume of the explosive and this molecular compression is followed at once by a much slower phase (1/1000 second) in which normal molecular pressures are regained, and then by a still slower and much less intense phase of negative pressure lasting 1/100 second. Near its source the molecules are forced outwards for a considerable distance before oscillating. Beyond this the wave of concussion is propagated like a sound wave from molecule to molecule, each molecule oscillating about its resting position. This asymmetrical wave is called a "shock pulse" and is unlike an ordinary sound wave where there is an equal average of compression and rarefaction.

A "shock pulse" may be defined as a sound wave of great condensation and great initial velocity. Near its source the velocity of propagation of a shock pulse is greater than the velocity of sound (that is, over 1100 feet per second). The reason why the shock pulse produces an auditory sensation is because its pressure changes occur within a time interval to which the ear is normally made to react. The ear is an organ made to react to changes of pressure. These changes of pressure must occur within certain time intervals. If the pressure change occurs more rapidly than 1/20 second but not faster than 1/20,000 second it will be recorded by the ear. Waves of pressure recurring regularly 1000 times a second are sensed as a 1000 cycle pure tone. The ear will respond to one pressure change as well as to a series of these pressure changes. When the ear is stimulated by the irregular pressure or concussion pulse of an explosion we sense it as a "bang" or "crack." The pressure intensity of a shock pulse is enormously greater than that of ordinary sound waves. The ear can detect as sound the waves of a 1000 cycle tone whose pressure variations are 1/5 billionth of an atmosphere. The pressure fluctuation of a shock pulse may be many billions times this or many atmospheres.

The great destructive power of the shock pulse is in part due to the sudden enormous rise in temperature that results in the development of great pressure. As it is propagated, the intensity of the shock pulse falls off more rapidly than the inverse square law for ordinary sound, hence distance of the subject from the source is important. Variations in the shape of the shock pulse occur with changes in the type of explosive. Gunpowder used to propel the bullet burns in about 1/1000 second. T.N.T. used to explode the bullet burns in about 1/100,000 second. Variations in the shape of the shock pulse produce variation in the auditory sensation. The major disturbance set up in the conducting mechanism by a shock pulse as recorded from the head of the malleus is a single asymmetrical fast positive and negative wave lasting about 1/1000 second. This wave is many times larger than any of the associated secondary waves and is the important traumatizing factor. Furthermore, the induced oscillation is only about 1/20 as long as the time needed to initiate a contraction of the middle ear muscles. Hence the middle ear muscles cannot protect the auditory mechanism from the shock pulse. The oscillation in the conducting mechanism sets up a violent, brief oscillation of the basilar membrance and organ of Corti. Injury to the end organ may thus occur again.

The earliest manifestation of this trauma is a localized dip in the audiogram between 4000 and 6000 cycles. This can be produced by exposing a normal subject to the shock pulse of a blank cartridge 3 feet from the ear, but not all subjects so exposed will show an effect—illustrating that constitutional factors are present. When a localized drop in the audiogram is so produced recovery occurs in about 30 minutes. If the trauma is more severe the changes in the audiogram become irreversible at about this frequency. With still further trauma the higher frequencies are involved. Even in most severe trauma to the perceptive mechanism, hearing for frequencies below 1000 cycles is only slightly affected. A certain amount of recovery reaction occurs in all cases. In severe trauma this recovery period is a matter of hours or days after which time little improvement in function as reflected in the audiogram can be expected. Tinnitus however may endure long after the injury but here also some degree of initial improvement is observed.

Besides injuring the perceptive mechanism, the wave of concussion or shock pulse may produce more gross and hence more readily observed ear injury. This is the injury to the conducting mechanism. Cerumen plugs may be driven against the drum. The dynamic pressure of the shock pulse may be severe enough to rupture the drum, fracture the ossicles, injure the incudo mallear and incudo stapedial articulation, or cause hemorrhage. Experimentally in a fresh human cadaver

ear you can produce a small central perforation of the drum with the shock pulse of a blank cartridge fired 1 inch from the external meatus. The injured conducting mechanism usually heals well. Even large defects of the drum are healed over so that little permanent damage to these structures and their function is observed. If infection supervenes permanent changes may result such as a chronic perforation of the drum or lesions of the ossicular chain. Of course the blast wave may be strong enough to fracture the temporal bone as well as other cranial bones. If the fracture occurs through the labyrinth capsule there is total loss of cochlear and vestibular function. Usually such severe injury results in so much associated trauma to the skull and brain that death results.

V.

In some bombing operations large numbers of individuals, particularly civilians, have been exposed to injury from blast. Observations made during the Spanish Civil War show that anyone within a radius of 50 feet from an exploding 200-pound bomb is liable to show rupture of the drum and bleeding from the ear. Eighty-five per cent of these injuries are due to the blast wave and only 15 per cent to bomb fragments. Any wall or partition can effectively shield the individual from the shock pulse. Middle ear injury was observed in only 0.5 per cent of the individuals within a building adjacent to the street where the bomb struck. Protection of the ear itself from the shock pulse may be obtained by plugging the ear with cotton. Many commercial ear obturators, to be used particularly in noisy industries, have been developed.

In general, protection to the ear itself should be possible for civilians and for men in military training. In action, however, they are impractical because they cannot be kept clean and they deafen the individual. The man in action needs all his hearing to understand speech, to evaluate accurately his surroundings and to sense danger. Conversely, however, the deafening effect of noise may interfere with the man's ability to hear the whispered voice and to judge accurately his surroundings. Helmets protect the pilot from engine and propeller noise but pilots are exposed to the steady static noise in their tightly strapped receivers and, in addition, to powerful telephone receiver clicks (similar to shock pulses) from transient electrical disturbances. The pilot must be able to unscramble the speech spectrum superimposed on the background noise in his receiver, and in spite of the deafening effect of these powerful acoustic transients. Training and familiarity with the subject matter conveyed in his interplane and plane-to-ground communication makes this possible most of the time. In addition it is vital to hear the beam signal and note change in its

loudness. The frequency of the beam signal must be below the point where the effects of trauma occur.

While the audiometer is an important tool in defining ear injury due to acoustic trauma, the findings so obtained must be viewed from the broad perspective of hearing as a highly developed cortical function. A gradual hearing loss is not as noticeable as a sudden loss. While the pilot and many other individuals make great demands on their auditory sense, many people, as in civilian life, demand much less of their auditory sense. It is important to remember this in evaluating an audiogram. Therefore, you cannot look at an audiogram and predict the amount of complaining that its owner will do. Clinical experience with large numbers of deafened individuals shows that people differ greatly in their consciousness of handicap—even where they show identical hearing loss in the audiogram. A musician may sense a hearing loss early, while a laborer with the same amount of loss may not be particularly aware of it. Not only is there a difference in individuals in the demand they make on their auditory sense but there are great differences in the utilization of what hearing they have. The higher centers subserving audition assist us in reconstructing improperly received auditory stimuli and thus in making them understandable. Our ability to understand the voice over a poor telephone transmitter is an example of this. In the older and more inefficient telephone systems practically all of the acoustic energy transmitted was around 1000 cycles. Very little of the lower and higher speech frequencies came through to the listener, yet speech was not only understandable but slight variations between individual speakers could be detected. The higher auditory centers here operate to piece together the incomplete and distorted acoustic spectrum received over the telephone into understandable speech. Similarly a deafened individual can understand the spoken voice even though he is receiving a small part of the acoustic spectrum of speech. An auditory memory function probably supplies that portion of the speech spectrum that fails to get through the ear. This ability varies greatly with the individual.

In conclusion I hope I have helped you to understand some of the specific acoustic and physiological factors that relate noise and concussion to the auditory sense, and to understand what kind of damage to the sense organs and to hearing may result from exposure to these stimuli.

ABSTRACTS OF CURRENT ARTICLES

(Continued from Page 284)

The sixth study was an experimental investigation of lip-reading. Motion picture tests of lip-reading were found to be highly reliable. Great individual differences in lip-reading performance exist between children of the same chronological age, which were not due to differences in length of training. A coefficient of correlation of .54 was found between lip-reading and educational achievement. *(Abstracted by Mary Fry, Wisconsin.)*

Crowe, S. J., Guild, S. R., Langer, E., Lock, W. E. and Robbins, M. H. Impaired hearing in school children, *Laryngoscope*, 1942, 52, 790-804.

A report based upon the examination of 1,365 white children from eight to fourteen years of age, attending the Baltimore schools, showed that the most common hearing defect in children is impairment of thresholds for some or all of the frequencies higher than 2048 cycles per second. Nearly 40 per cent of the children had such impairments. Much deafness can be prevented by organizing educational campaigns that will give physicians a chance to treat all cases of acute otitis media promptly. It is possible to restore the hearing of many children with impairment for conversational voice and thus to simplify the educational problem for them, for their parents and for the communities. Parents should be instructed in the value of wearable hearing aids to the hard-of-hearing child in helping him to hear, learn to speak clearly, to get an education and develop a normal personality. It is important to do everything possible to prevent the development of middle ear lesions in a child with an inner ear type of impaired hearing, because when there is added to the high-tone loss even a moderate impairment of the thresholds for middle and low tones the individual is severely handicapped in the activities of daily life, and, if a child, he or she has great difficulty in acquiring an education.

Fry, D. B., Squadron Leader (Royal Air Force). A suggestion for a new method of testing hearing in aviation candidates, *J. Laryngology and Otology*, 1942, 57, 11-13.

The author states that there is general agreement that the hearing test in use at the present time for the selection of flying personnel is not satisfactory. He recommends replacing the present test with a functional one which will indicate the suitability of a candidate for the duties which he is to undertake. In the Service a man must be able to hear, recognize and interpret auditory signals, whether speech or Morse. Ability to interpret signals depends on both hearing and intelligence. The question is further complicated by the factor of a noise background in which the candidate may have to work. Various kinds of articulation testing of candidates' ability to receive correctly speech sounds, syllables and sentences should be carried out in conditions approximating those in which the candidate will have to work.

Some questions concerning the functional aspect of hearing which are directly connected with the problem of signals include the following: (1) The importance of training in the reception of transmitted speech. How far can training compensate for defects of hearing (as shown by pure tone audiometry)? (2) What is the effect of monaural deafness on the ability to receive signals? (3) What is the effect of frequency and intensity limitations in the transmission system upon the reception of signals by a person with defective hearing? *(Abstracted by Mary Fry, Wisconsin.)*

Gerebtzoff, Michel A., Récherches sur la Projection Corticale du Labyrinthe. I. DesÉffets de la Stimulation Labyrinthique sur l'Activité Électrique de l'Écorce Cerébral, *Archives Internationales de Physiologie*, 1940, 50, fasc. I.

M. Gerebtzoff, reporting from the general pathological laboratory of the University of Brussels, stimulated both branches of the auditory nerve of the cat through faradic excitation. He concludes that the vestibulo-cerebral path is homolateral and that diffusion of effect from this pathway is sub-cortical. He posits different central adaptation of the acoustical and vestibulary systems to stimuli of brief duration. *(Abstracted by Jeanette Anderson, Purdue.)*

Harbert, F., Commander, Medical Corps, U. S. Navy. Functional and simulated deafness, *United States Naval Medical Bull.*, 1943, 41, 458-471 and 717-728.

The author differentiates between malingering and hysteria in functional deafness. Firestone's term, volitional deafness, which covers the entire group of simulated, exaggerated, and functional deafness is considered useful. Malingerers are divided according to mentality into normal, degenerate, and hysterical. Methods of detecting the malingerer are described. In the case of both malingerers and hysterics the deafness is usually unilateral. A functional disorder of attention frequently accompanies hysterical deafness. A symptom sometimes referred to as hysterical sensory aphasia is seen in the individual who may admit normal hearing by audiogram but allege total deafness for speech. Cures obtained by strong suggestion are seldom permanent unless followed up by conscious explanation, discussion, and rationalization of the patient's condition. The patient is told that at first his deafness was real and consequently after a time he ceased to listen. He is informed that listening is an active process like walking and requires conscious effort on his part until it becomes automatic again.

Simulated deafness is discussed in connection with neurasthenia, anxiety neurosis, and hypochondria.

Inconsistency is the criterion of diagnosis in simulated and functional deafness. A functional element should be suspected in every case of deafness very greatly improved by a simple procedure or in which the degree of deafness fluctuates markedly. The distinguishing factor between simulation and hysterical deafness is insight of the patient. The motives may be similar in both. If insight is present the patient is either psychologically normal or a constitutional psychopath. If insight is lacking, the patient is either hysterical, neurasthenic, or a combination of these. A valuable table is presented by the author to be used in establishing whether insight is present.

Hill, F. T. The changing conception of the management of chronic progressive deafness, *Annals of Otology, Rhinology and Laryngology*, 1942, 51, 653-661.

This is a historical review and critical analysis of the theories and techniques of treating deafness for the past twenty-five years. The realization has come that all therapeutic efforts finally come down to prevention; correction by circumvention, or amplification; or rehabilitation. Recognition is given to the effect of tubal obstruction, of negative pressure, and attempts to remedy its cause, either by local treatment, surgical measures in the nose or throat, or by irradiation. Otologists are urged to keep in mind the possibility of toxic absorption and strive to eradicate foci of infection when indicated. Correction of nutritional or endocrine deficiency is advised. Operative treatment may be suggested for those who meet all the requirements laid down for successful fenestration. The importance of cultivating a personal interest in each patient, adapting treatment to individual circumstances and condition is stressed in the interests of assisting the patient to achieve an improved social and economic life.

WAR NOTES

HERBERT KOEPP-BAKER, Editor
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The Committee on Rehabilitation of the American Speech Correction Association met in Chicago on June 26 and 27. Through a fortunate coincidence, Drs. Warren Gardner, Wendell Johnson, Delyte Morris and Scott Reger were in Chicago at the same time. Since certain important decisions as to policy and action had to be made immediately, their opinions and advice were sought by the Committee.

One of the principal items of business transacted concerned a communication received by the Committee from the Office of the Surgeon-General, and transmitted by Major Walter N. Barton of its Medical Corps. This communication requested that the Committee make recommendations covering qualifications for Lip Reading Aides for rehabilitation of cases of hearing loss in the army. The Committee recognized in this request an opportunity to exert a valuable influence in setting up a satisfactory re-educative service for this type of handicapped person. These recommendations were drafted and have been transmitted to the Office of the Surgeon-General. The Committee made an earnest effort to recommend qualifications that would assure the best possible clinical service in this area.

Increasingly large numbers of war casualties are being returned to the United States for rehabilitation. This has increased the interest of authorities in specialized speech correction service. It has also emphasized the importance of a complete roster of speech clinicians who might be available for service. The Committee has continued to work on improvements of the roster suggested by recent changes in the rehabilitation outlook.

A large number of basic problems of policy and procedure in the total field of rehabilitation tend to delay a detailed consideration of clinical speech services by certain of the army and navy medical and educational agencies. The Committee recognizes that the task of adequately informing *all* rehabilitation authorities of the nature and importance of clinical speech is yet far from complete.

Both the Surgeon-General's Office and the Veterans' Administration have, however, requested a brief circular which will help their medical agencies identify and describe the major types of speech disabilities which are likely to be found among war casualties, and a summary of the methods which are employed in the treatment of persons suffering from such disorders. The preparation and distribution of such technical

information to the proper authorities will greatly extend an understanding and appreciation of the work of the speech clinician.

A recent report from the Defense Co-ordinator to the Committee on Rehabilitation provided the Committee with further informaton on the developments in Washington. These developments are summarized in the Notes which follow:

Colonel Roy D. Halloran, in charge of the Neuro-Psychiatric Service in the Surgeon-General's Office, undertook to study systematically the needs for clinical speech service in the Mental Hygiene Units of the Army. He also expressed his intention of studying and evaluating the existing clinical speech services which are operating somewhat independently in a number of army camps and which were reported in the War Notes in the last issue of the *Journal*.

Colonel Halloran also encouraged the Committee on Rehabilitation to establish more intimate relations with the neuro-psychiatrists and plastic surgeons in the various army hospitals. The Defense Coordinator has already visited the Valley Forge General Hospital at Phoenixville, Pennsylvania, the Deshon Hospital at Butler, Pennsylvania, and the Walter Reed General Hospital in Washington, D. C. The general procedures employed in re-education at these army hospitals are being studied carefully with the intention of relating speech correction services to their general program. The Rehabilitation Committee plans to have visitors sent to the Bushnell General Hospital at Brigham, Utah, and the O'Reilly General Hospital, Springfield, Missouri. Recent advices suggest that the maxillo-facial surgeons and dentists in these hospitals will support the Committee's recommendations for the employment of speech correctionists in post-operative treatment of head and neck injuries.

Dr. Charles Griffith, Medical Director of the Veterans' Administration, and Dr. E. J. Rose, Chief of the General hospitals and Assistant Medical Director of the Veterans' Administration, are helping the Committee to establish contacts for study of the need of clinical speech in the Veterans' Administration hospitals located at Los Angeles, California, Hines, Illinois, The Bronx, New York, Washington, D. C., Atlanta, Georgia, Portland, Oregon, and St. Louis, Missouri. It is the intention of the Committee to send visitors to some of these hospitals in the near future. Dr. John A. Pringle, Assistant Medical Director of the Veterans' Bureau and Chief of the Division of Neuro-Psychiatry of that agency, is aiding the Committee in arranging service relations with the departments of neuro-psychiatry in these hospitals.

H. R. Bill 2536 was passed by Congress and approved by the President on July 6, 1943. This bill provides vocational rehabilitation for non-service-connected civilians "serving in war industries, civilian defense units, and maritime industries." The final disposition of this legislation in Congress now provides two separate rehabilitation structures. Senate Bill 786 already provided physical and vocational rehabilitation under Veterans' Administration for men discharged from the army and navy because of war-induced disabilities. This second and most recent legislation will provide rehabilitation for all other army and navy men who were accepted for service but found to possess disabilities. It will also service civilians in defense and maritime work. Since the Veterans' Act runs for only six years after the war, its remaining service-connected cases will be ultimately serviced under provisions of this H. R. Act 2536.

H. R. Act 2536 provides immediate physical care including physician's and specialistic services, corrective operations, hospitalization, occupational and vocational care.

The exact details of administration under which this new bill will operate are now being formulated by the Bureau of Vocational Rehabilitation of the United States Department of Education for the Social Security Administration. Mr. John Kratz, who has long headed this Bureau, has asked the Committee to prepare recommendations for clinical speech service under this program. Both Captain Watson Miller, Social Security Administrator, and Mr. John Kratz have assured the Committee that the speech needs of its clients will receive careful consideration and that the Association will be called upon to provide specialistic services as a part of its total program under this act.

H. R. Act 2536 also provides that the states shall appropriate one dollar for every two dollars of Federal appropriation for the rehabilitation services it sets up. The former ratio for Vocational Rehabilitation was one to one.

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